SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

AUDUBON AND HIS JOURNALS.

THE memory of Audubon is dear to the hearts of the American people. The vigor and versatility of his writings, the eminence he attained as a naturalist, and his high personal character won him the admiration of his contemporaries and made him an honored son in the land of his adoption. Born at an opportune time and transported to the New World when still a lad, he undertook and accomplished one of the most gigantic tasks it has ever fallen to the lot of one man to perform. Although for years deflected from the course Nature had laid out for him, and tortured by half-hearted attempts at a commercial life against which his restive spirit rebelled, he finally broke loose from his bondage and devoted the remainder of his days to the grand work which has made his name immortal.

Audubon was a man of phenomenal powers of endurance and indomitable courage; his determination, perseverance and force of character are shown by the way he overcame seemingly insuperable obstacles. Is it not extraordinary that a person of his humble means should not only complete such an unparalleled series of paintings but should cross the ocean, make friends and admirers of noblemen and leading men of science, and succeed, in spite of the enormous cost, in bringing out in colors an atlas of 435 double elephant folio plates of birds?

His magnificent contributions to the natural history of the New World have not been surpassed. The best known of these is the *Birds of America*.* The equally

*The plates were originally issued in 87 parts, covering a period of twelve years (1827–1838). The

sumptuous *Quadrupeds of North America*, the text of which was published under joint authorship with Dr. John Bachman of Charleston (1846–1854), was apparently not begun until the bird books had been completed.

Audubon's fame as a painter of birds is world wide and his *Birds of America* is described by an eminent ornithologist as 'by far the most sumptuous ornithological work ever published.' His genius and power as a painter of mammals was even greater though less widely known, owing to the rarity of his magnificent folio plates of 'Quadrupeds.' He must have been nearly seventy when he began these drawings and it is no wonder he was not able to finish all of them himself. Happily, his sons Victor and John Woodhouse inherited his talent and were able to complete the series, thus perfecting a work the equal of which no other man or country has yet produced.

One is surprised at the misgivings with which Audubon undertook the preparation of the *Ornithological Biography*, as shown by an entry in his journal for October 16, 1830, where he writes depreciatingly: "I know that I am a poor writer, that I scarcely can manage to scribble a tolerable English letter, and not a much better one in French, though that is easier to me. I know I am not a scholar, but meantime I am aware that no living man knows better than I do the habits of our birds; no man living has studied them as much as I have done, and with the assistance of my old journals and memorandum-books which were written on the spot, I can at least put down plain truths, which may be useful and perhaps interesting, so I shall set to at once. I cannot, however, give *scientific* descriptions, and here must have assistance." This technical assistance was rendered by the well-known ornithologist, William MacGillivray. And many years later, when Audubon joined forces with John Bachman in the preparation of their great work on Mammals, the latter author looked after the technicalities. It must not be inferred from this that Audubon lacked a scientific knowledge of the distinctive characters of species; on the contrary he had a keen appreciation of these matters as every one knows who is familiar with his writings, but the drudgery of preparing technical diagnoses was so distasteful to him, and he was kept so busy with his paintings and biographies, that he preferred to let others do this part of the work.

The absence of a trustworthy biography of Aububon has been a matter of such general regret that the recent appearance of two handsome volumes entitled *Audubon and his Journals** is hailed with widespread satisfaction. The author, Miss Maria R. Audubon, a daughter of John Woodhouse Audubon and granddaughter of the celebrated naturalist, had the rare advantage of familiarity with the family traditions and the possession of unpublished manuscripts. She has supplied not only a reliable and entertaining account of Audubon's life, but also the full text of his most important journals—those of his trips to Europe, Labrador, and the Missouri and Yellowstone Rivers. Many of his journals and manuscripts were early destroyed by fire, and others lost, but happily those of greatest value have been discovered and are now for the first time made public. From these we learn so much of interest that only the merest outline can be given here.

text, entitled *Ornithological Biography*, was not begun until 1830, and the original five volumes appeared at intervals from 1831 to 1839.

**Audubon and His Journals.* By Maria R. Audubon, with Zoological and other Notes by Elliott Coues. New York, Charles Scribner's Sons. December, 1897. Large 8vo. Vol. I., pp. xiv+532, pls. 22; Vol. II., pp. viii+654, pls. 15. $7.50.

Since the object of the present article is to call attention to the fund of information contained in the journals nothing need be said of Audubon's personal history or the vicissitudes of his early and middle life.

In his search for mammals and birds Audubon traveled thousands of miles afoot in the Eastern and Southern States, from Maine to Florida, Louisiana and Texas, and made special expeditions to Labrador and the Yellowstone—the latter at a time of life when most men who have lived to reach such a ripe age seek the quiet and comforts of home. It was on this latter trip he wrote: "I am getting an old man, for this evening I missed my footing on getting into the boat and bruised my knee and elbow, but at seventy and over I cannot have the spring of seventeen."

In 1833, when about sixty years of age, Audubon chartered a schooner and with his son John Woodhouse, and four other companions, set sail for Labrador to obtain additional material for his great work on the *Birds of America*. The journal of this cruise overflows with interesting observations in natural history and is of special value to the ornithologist. Now and then an error of interpretation creeps in, as when 'tracks of Deer and Caribou' are mentioned—for the only deer in Labrador is the Caribou—and when glacier-carried boulders are supposed to have been cast up by the sea.

On their way the party visited Bird Rock in the Gulf of St. Lawrence. It was on the 14th of June, and "at eleven," Audubon writes, "I could distinguish its top plainly from the deck, and thought it covered with snow to a depth of several feet; this appearance existed on every portion of the flat, projecting shelves. Godwin [the pilot] said, with the coolness of a man who had visited this rock for ten successive seasons, that what we saw was not snow—but Gannets! I rubbed my eyes, took my spy-glass, and in an instant the strangest picture stood before me. They were birds we saw,—a mass of birds of such a size as I never before cast my eyes on. The whole of my party stood astounded and amazed, and all came to the conclusion that such a sight was of itself sufficient to invite any one to come across the Gulf to view it at this season. The nearer we approached, the greater our surprise at the enormous number of these birds, all calmly seated on their eggs or newly hatched brood, their heads all turned to windward."

On the 17th of June the party reached South Labrador, in the neighborhood of Natasquan, and Audubon wrote in his journal: "The shores appeared to be margined with a broad and handsome sand-beach; our imaginations now saw Bears, Wolves, and Devils of all sorts scampering away on the rugged shore." A little later he continues:

"And now we are positively on the Labrador coast, Latitude 50° and a little more,—farther north than I ever was before. But what a country! When we landed and passed the beach, we sank nearly up to our knees in mosses of various sorts, producing as we moved through them a curious sensation. These mosses, which at a distance look like hard rocks, are, under foot, like a velvet cushion. We scrambled about, and with anxiety stretched our necks and looked over the country far and near, but not a square foot of *earth* could we see. A poor, rugged, miserable country; the trees like so many mops of wiry composition, and where the soil is not rocky it is boggy up to a man's waist."

A few days later he gave a more pleasing picture:

"The country, so wild and grand, is of itself enough to interest any one in its wonderful dreariness. Its mossy, gray-clothed rocks, heaped and thrown together as if by chance, in the most fantastical groups im-

aginable, huge masses hanging on minor ones as if about to roll themselves down from their doubtful-looking situations, into the depths of the sea beneath. Bays without end, sprinkled with rocky islands of all shapes and sizes, where in every fissure a Guillemot, a Cormorant, or some other wild bird retreat to secure its eggs and raise its young, or save itself from the hunter's pursuit. The peculiar cast of the sky, which never seems to be certain, butterflies flitting over snow-banks, probing beautiful dwarf flowerets of many hues pushing their tender stems from the thick bed of moss which everywhere covers the granite rocks. Then the morasses, wherein you plunge up to your knees, or the walking over the stubborn, dwarfish shrubbery, making one think that as he goes he treads down the *forests* of Labrador."

Those who have felt the fury and grandeur of a Labrador storm will appreciate Audubon's description of one he witnessed July 10, 1833, when the blasts 'seemed strong enough to rend the very rocks asunder.' He says:

"The rain is driven in sheets which seem scarcely to fall on sea or land; I can hardly call it rain, it is rather a mass of water, so thick that all objects at any distance from us are lost to sight every three or four minutes, and the waters comb up and beat about us in our rock-bound harbor as a newly caged bird does against its imprisoning walls. The great Black-backed Gull alone is seen floating through the storm, screaming loudly and mournfully as it seeks its prey; not another bird is to be seen abroad; the Cormorants are all settled in the rocks close to us, the Guillemots are deep in the fissures, every Eider Duck lays under the lee of some point, her brood snugly beneath her opened wings, the Loon and Diver have crawled among the rankest weeds * * * and the gale continues as if it would never stop."

Ten years after the Labrador trip Audubon made his famous expedition to the junction of the Missouri and Yellowstone Rivers. The journals of this expedition, which was undertaken solely for the sake of his work on the Quadrupeds of North America, are storehouses of information. He set out from New York for St. Louis, March 11, 1843, and took with him Edward Harris, John G. Bell, Isaac Sprague and Lewis Squires. The party left St. Louis by river steamboat on the 25th of April, but owing to contrary winds, innumerable sandbars, and the delays incident to cutting firewood for the engine along the way, it was the 12th of June before they reached Fort Union.

In those days Parakeets were common along the Missouri, and were seen, the journal states, near St. Joseph, Missouri; at Fort Leavenworth, Kansas; near the mouth of the Platte River, Nebraska; near Council Bluffs, Iowa, and at several points near Great Bend, South Dakota. Big game abounded everywhere. An important record is that of the Black-tail or Mule Deer at the mouth of Little Sioux River, Harrison County, Iowa, where four were seen May 12, 1843. This species was long before exterminated in this region and is not included in Allen's list of the mammals of Iowa, published in 1869. Two weeks later one was shot and others seen at Great Bend, South Dakota.

Elk or Wapiti were noted at various places in Nebraska and Dakota from opposite the mouth of the Little Sioux River northward; Antelope were said to occur within 25 miles of Fort Vermilion, South Dakota, and the first Buffaloes were observed near the mouth of the James River in the same State. A little higher up the latter animals were seen constantly and often in enormous numbers.

Before reaching Fort Pierre the party met a curious boat which "instead of being

made of wood, had only a frame, covered with Buffalo skins with the hair on." The two occupants "had been nine days coming 150 miles, detained every day, more or less, by Indians."

In the entry for May 25th, Audubon mentions meeting three Mackinaw barges a little below the mouth of White River, South Dakota. "On the roofs of the barges" he writes "lay much Buffalo meat, and on the island we left this morning probably some hundreds of these poor animals, mostly young calves, were found dead at every few steps; and since then we have passed many dead as well as many groups of living. In one place we saw a large gang swimming across the river; they fortunately reached a bank through which they cut their way towards the hills." Later the same day he says: "Within the last mile or so we must have passed upwards of a hundred drowned young Buffalo calves, and many large ones." On the 28th, between Great Bend and Fort George "both shores were dotted by groups of Buffaloes as far as the eye could reach," and by noon he estimated that he had seen more than 2000.

On the 6th of June Audubon stopped to see the famous Mandan village, on the west side of the Missouri nearly opposite the spot now occupied by Bismarck, the capital of North Dakota. The inhabitants at the time were mainly Riccarees, the Mandans having been almost exterminated by small pox 5 or 6 years before. In his journal Audubon thus describes the appearance of the village and its inmates: "The Mandan mud huts are very far from looking poetical, although Mr. Catlin has tried to render them so by placing them in regular rows, and all of the same size and form, which is by no means the case. But different travellers have different eyes! We saw more Indians than at any previous time since leaving St. Louis, and it is possible that there are a hundred huts, made of mud, all looking like so many potato winter-houses in the Eastern States. * * The appearance of these poor, miserable devils, as we approached the shore, was wretched enough. There they stood in the pelting rain and keen wind, covered with Buffalo robes, red blankets, and the like, some partially and most curiously besmeared with mud; and as they came on board, and we shook hands with each of them, I felt a clamminess that rendered the ceremony most repulsive."

The Bighorn or Mountain Sheep, which still occurs sparingly in the 'badlands' of North Dakota, was then abundant and not infrequently appeared along the Missouri near the mouth of the Yellowstone, where a band of 22 was observed by Audubon and his associates.

At length, on the 12th of June, 48 days after setting out from St. Louis, the party arrived at the end of their journey and were heartily welcomed and hospitably entertained by Mr. Culbertson, the fur trader in charge of Fort Union.

Speaking of his quarters at the fort Audubon says: "Our room was small, dark, and dirty, and crammed with our effects. Mr. Culbertson saw this, and told me that to-morrow he would remove us to a larger, quieter, and better one. I was glad to hear this, as it would have been very difficult to draw, write, or work in; and yet it is the very room where the Prince de Neuwied [Maximilian, Prince of Wied] resided for two months, with his secretary and bird-preserver. The evening was cloudy and cold; we had several showers of rain since our bath in the bushes this morning, and I felt somewhat fatigued. Harris and I made our beds up; Squires fixed some Buffalo robes, of which nine had been given us, on a long old bedstead, never knowing it had been the couch of a foreign prince; Bell and Sprague settled themselves opposite to us on more Buffalo skins, and night closed in."

The journal of the stay at Fort Union is a running account of the daily life at this remote outpost, with records of hunting—particularly Buffalo and Wolf hunting—and observations on the habits of birds, mammals, Indians, half-breeds, and traders, interspersed with graphic episodes and descriptions of the country. Audubon speaks also of his labors in painting new birds and quadrupeds—the real object of his trip—and tells of the successes and disappointments attending his ceaseless efforts to obtain new or rare specimens.

Wolves were very abundant about the fort and were often shot from the ramparts. A week after Audubon's arrival his journal contains this record: "*June 19, Monday.* It began raining early this morning; by 'early,' I mean fully two hours before daylight. The first news I heard was from Mr. Chardon, who told me he had left a Wolf feeding out of the pig's trough, which is immediately under the side of the fort. The next was from Mr. Larpenteur, who opens the gates when the bell rings at sunrise, who told us he saw seven Wolves within thirty yards, or less, of the fort. I have told him since, with Mr. Chardon's permission, to call upon us before he opens these mighty portals, whenever he espies Wolves from the gallery above, and I hope that to-morrow morning we may shoot one or more of these bold marauders. Sprague has been drawing all day, and I a good part of it; and it has been so chilly and cold that we have had fires in several parts of the fort. Bell and Harris have gone shooting this afternoon, and have not yet returned. Bell cleaned the Wolf shot last night, and the two Antelopes; Old Provost broiled brine, and the whole of them are now in pickle. * * * * —*Later.* Harris and Bell have returned, and, to my delight and utter astonishment, have brought two new birds: one a Lark, small and beautiful [named by Audubon, Sprague's Lark and now known to naturalists as *Anthus spragueï*]; the other like our common Golden-winged Woodpecker, but with a red mark instead of a black one along the lower mandible running backward." A few days later he adds some valuable notes on the habits of the Lark: "The little new Lark that I have named after Sprague has almost all the habits of the Skylark of Europe. Whilst looking anxiously after it, on the ground where we supposed it to be singing, we discovered it was high over our heads, and that sometimes it went too high for us to see it at all. * * * * * * The male rises by constant undulations to a great height, say one hundred yards or more; and whilst singing its sweet-sounding notes, beats its wings, poised in the air like a Hawk, without rising at this time; after which, and after each burst of singing, it sails in divers directions, forming three-quarters of a circle or thereabouts, then rises again, and again sings; the intervals between the singing are longer than those which the song occupies, and at times the bird remains so long in the air as to render it quite fatiguing to follow it with the eye. Sprague thought one he watched yesterday remained in the air about one hour. Bell and Harris watched one for more than half an hour, and this afternoon I gazed upon one, whilst Bell timed it, for thirty-six minutes."

The journal of the return trip from Fort Union contains many interesting records, the general character of which may be gleaned from the following:

August 16. Started from Fort Union at 12 M. in the Mackinaw barge 'Union.' Shot five young Ducks. Camped at the foot of a high bluff. Good supper of Chickens and Ducks.

Thursday, 17th. Started early. Saw three Bighorns, some Antelopes, and many Deer, fully twenty; one Wolf, twenty-two Swans, many Ducks. Stopped a short time on a bar. Mr. Culbertson shot a female Elk, and I killed two bulls. Camped at Buffalo Bluff, where we found Bear tracks.

* * * * * *

Saturday, 19th. Wolves howling, and bulls roaring, just like the long continued roll of a hundred drums. Saw large gangs of Buffaloes walking along the river. * * *

Sunday, 20th. Thousands upon thousands of Buffaloes; the roaring of these animals resembles the grunting of hogs, with a roaring sound from the throat. * * *

Monday, 21st. Buffaloes all over the bars and prairies, and many swimming; the roaring can be heard for miles. The wind stopped us again at eight o'clock; breakfasted near the tracks of Bears surrounded by hundreds of Buffaloes. We left our safe anchorage and good hunting grounds too soon; the wind blew high, and we were obliged to land again on the opposite shore, where the gale has proved very annoying. Bear-tracks led us to search for these animals, but in vain.

Tuesday, 22d. * * * In the afternoon we started again and went below the Little Missouri, returned to the bull and took his horns, etc. Coming back to the boat Sprague saw a Bear; we went towards the spot; the fellow had turned under the high bank and was killed in a few seconds. * * *

Thursday, 24th. A bad night of wind, very cloudy * * * traveled about twenty miles when we were again stopped by the wind. Hunted but found nothing. The fat of our Bear gave us seven bottles of oil. We heard what some thought to be guns, but I believed it to be the falling of the banks. Then the wolves howled so curiously that it was supposed they were Indian dogs. We went to bed all prepared for action in case of an attack; pistols, knives, etc., but I slept very well, though rather cold. * *

Thursday, 31st. Started early; fine and calm. Saw large flocks of Ducks, Geese, and Swans; also four Wolves. Passed Mr. Primeau's winter trading house; reached Cannon Ball River at half-past twelve. No game; water good-tasted, but warm. Dinner on shore. Saw a Rock Wren on the bluffs here. Saw the prairie on fire, and signs of Indians on both sides. * * *

Thursday [*Sept.*] *7th.* About eleven o'clock last night the wind shifted *suddenly* to northwest, and blew so violently that we all left the boat in a hurry. Mrs. Culbertson [Indian wife of the Ft. Union trader], with her child in her arms, made for the willows, and had a shelter for her babe in a few minutes. Our guns and amunition were brought on shore, as we were afraid of our boat sinking. We returned on board after a while; but I could not sleep, the motion making me very sea-sick; I went back to the shore and lay down after mending our fire. It rained hard for about two hours; the sky then became clear, and the wind wholly subsided, so I went again to the boat and slept till eight o'clock. A second gale now arose; the sky grew dark; we removed our boat to a more secure position, but I fear we are here for another day. Bell shot a *Caprimulgus*, so small that I have no doubt it is the one found on the Rocky Mountains by Nuttall, after whom I have named it. [Now known as Nuttall's Poor-will.] * *

Thursday, [*Sept.*] *28th.* A beautiful morning, and we left at eight. The young man who brought me the calf at Fort George has married a squaw, a handsome girl, and she is here with him. Antelopes are found about twenty-five miles from this fort, but not frequently. Landed fifteen miles below on Elk Point. Cut up and salted the cow. Provost and I went hunting, and saw three female Elks, but the order was to shoot only bucks; a large one started below us, jumped into the river, and swam across, carrying his horns flat down and spread on each side of his back; the neck looked to me about the size of a flour-barrel. Harris killed a hen Turkey, and Bell and the others saw plenty but did not shoot, as Elks were the order of the day. I cannot eat beef after being fed on Buffaloes.

In another place he speaks of beef as 'very inferior to Buffalo.'

Notwithstanding the incredible abundance of Buffaloes at this time Audubon foresaw their inevitable doom, as shown by a prophetic sentence in his journal: "But this cannot last; even now there is a perceptible difference in the size of the herds, and before many years the Buffalo, like the Great Auk, will have disappeared."

One is everywhere impressed by the voluminousness and vigor of the journals. Those who have felt the strain and fatigue of arduous field work know what it costs to write up one's notes at night, when as a rule physical weariness renders literary work out of the question. Manuscripts prepared under such conditions should be read between the lines and criticised with a lenient hand. As a rule the briefest entries follow the busiest days, and when Audubon exclaims, as he does in one place, "I could write a book on the experiences of to-day," it is easy to understand why he wrote so little. In fact, the marvel is that

a man of his age, and one so overwhelmed with work, had the strength and determination to write so much, and the mental clearness to write so well.

Miss Audubon has added to the Missouri River journals a number of footnotes quoting descriptions by early explorers—chiefly Lewis and Clark and Prince Maximilian—of places mentioned by Audubon, thus bringing together on the same page accounts of different authors who visited the region at different times.

Dr. Elliott Coues has supplemented these by another set of footnotes, over his initials, giving modern names of places and other information of geographic and historic interest; and biographical and zoological notes relating to persons and animals mentioned in the text. His familiarity with the region described, and with everything relating to its history, as well as with Audubon's books on birds and mammals, has enabled him to contribute materially to the interest and permanent value of the work. He calls attention to the first mention in the journals of three new species of birds — Bell's Vireo, Harris' Finch and Sprague's Lark—obtained on this expedition and named by Audubon after his companions; to the difference in song of the western Meadowlark from that of its eastern relative; and to the absence of any record of the first capture of the then new LeConte's Sparrow, which he learns from the 'Birds of America' was killed May 24, 1843; and so on.

Now and then he makes a slip, as when he states that the Fox Squirrel mentioned (on page 455 of Vol. I) under the name *Sciurus capistratus* is the one 'with white nose and ears, now commonly called *Sciurus niger*' [the latter is confined to the Southern States; the one to which Audubon refers is the Mississippi Valley Fox Squirrel, *S. ludovicianus*]; and when (p. 526) he ascribes to the late Thomas M. Brewer the introduction of the English Sparrow into this country.*

The close scrutiny Dr. Coues gave the text is indicated by the rarity of lost opportunities. The only really important omission noted relates to a mouse obtained at Fort Union on July 14, 1843, of which Audubon wrote in his journal: "Although it resembles *Mus leucopus* greatly, is much larger, and has a short, thick, round tail, somewhat blunted" (Vol. II, p. 89). Dr. Coues overlooked the fact that this particular specimen afterward became the type of *Mus missouriensis* Aud. & Bach., a species previously described by Maximilian under the name *Hypudæus leucogaster*, and later made by Baird the type of the genus *Onychomys*; it now stands as *Onychomys leucogaster* (Max. Wied.).

So much—and yet so little!—has been said of the Labrador and Missouri River Journals that no space remains to speak of the important 'European Journals,' the entertaining 'Episodes' and the admirable series of portraits† and other illustrations in Miss Audubon's excellent book—a work which no student of American birds, mammals, or history can afford to do without.

C. Hart Merriam.

THE IMPORT OF THE TOTEM.‡

In this study of the significance of the Omaha totem the aim will be to set forth, as clearly as possible, first, what these Indians believed concerning their totems, and,

* The English Sparrow was introduced into the United States in 1850 by Nicolas Pike. Nearly 25 years later Dr. Brewer took up his pen in defense of its introduction and from that time until his death was the Sparrow's only friend among American ornithologists.

†One of these, from a painting by Audubon's son, is reproduced as a frontispiece to the present number of Science by the courtesy of the publishers of the work, Messrs. Charles Scribner's Sons.

‡ A paper read before the Section of Anthropology, of the American Association for the Advancement of Science, at the Detroit Meeting, August, 1897.

secondly, what these totems stood for in the tribal structure.

There will be no attempt in this paper to treat the subject of totems in a world sense; the experience of many years of research within a limited area has shown the writer that close, careful studies of the various tribes and races of the two hemispheres are as yet too few to afford sufficient evidence for a final summing up, from which to deduce points held in common' or the equally important lines of divergence found in the beliefs and customs involved in the use of totems.

It is proper to call attention at the outset to a few of the perplexities of a research at first hand in a matter as recondite as that under consideration. There is the difficulty of adjusting one's own mental attitude, of preventing one's own mental atmosphere from deflecting and distorting the image of the Indian's thought. The fact that the implications of the totem are so rooted in the Indian's mentality that he is unconscious of any strangeness in them, and is unable to discuss them objectively, constitutes a grave obstacle to be overcome. Explanations of his beliefs, customs and practices have to be sought by indirect rather than by direct methods, have to be eliminated from a tangle of contradictions, and verified by the careful noting of the many little unconscious acts and sayings of the people, which let in a flood of light, revealing the Indian's mode of thought and disclosing its underlying ideas. By these slow processes, with the analysis of his songs, rituals and ceremonies, we can at last come upon his beliefs concerning nature and life, and it is upon these that the totem is based.

There were two classes of totems known among the Omahas: the Personal, belonging to the individual; and the Social, that of societies and gentes.

The Personal Totem.—The question first to arise is: How did the individual obtain his totem? We learn that it was not received from an ancestor, was not the gift of any living person, but was derived through a certain rite by the man himself.

In the Legend of the Sacred Pole of the Omahas, which has been handed down from generations, and which gives a rapid history of the people from the time when 'they opened their eyes and beheld the day' to the completed organization of the tribe, we are told: "The people felt themselves weak and poor. Then the old men gathered together and said, Let us make our children cry to Wa-kon'-da. * * * So all the parents took their children, covered their faces with soft clay, and sent them forth to lonely places. * * * The old men said, You shall go forth to cry to Wa-kon'-da. * * * When on the hills you shall not ask for any particular thing, * * * whatever is good, that may Wa-kon'-da give. * * * Four days and nights upon the hills the youth shall pray, crying, and when he stops shall wipe his tears with the palms of his hands, lift his wet hands to heaven, then lay them on the earth. * * * This was the people's first appeal to Wa-kon'-da."

This rite, called by the untranslatable name Non'-zhin-zhon, has been observed up to the present time. When the youth had reached the age of puberty he was instructed by his parents as to what he was to do. Moistened earth was put upon his head and face, a small bow and arrow given him, and he was directed to seek a secluded spot upon the hills, and there to chant the prayer which he had been taught, and to lift his hands wet with his tears to heaven, and then to lay them upon the earth; and he was to fast until at last he fell into a trance or sleep. If, in his trance or dream, he saw or heard anything, that thing was to become the special medium through which he could receive supernatural aid. The ordeal over, the youth returned home

to partake of food and to rest. No one questioned him, and for four days he spoke but little, for if within that time he should reveal his vision it would be the same as lost to him. Afterwards he could confide it to some old man known to have had a similar manifestation, and it then became the duty of the youth to seek until he should find the animal he had seen in his trance, when he must slay it and preserve some part of it (in cases where the vision had been of no concrete form, symbols were taken to represent it); this memento was ever after to be the sign of his vision, his totem, the most sacred thing he could ever possess, for by it his natural powers were to be so reënforced as to give him success as a hunter, victory as a warrior, and even the power to see into the future.

Belief concerning Nature and Life.—The foundation of the Indian's faith in the efficacy of the totem rested upon his belief concerning nature and life. This belief was complex and involved two prominent ideas: first, that all things, animate and inanimate, were permeated by a common life; and, second, that this life could not be broken, but was continuous.

The Common Life.—The idea of a common life was in its turn complex, but its dominating force was conceived to be that which man recognized within himself as will-power. This power which could make or bring to pass he named Wa-kon'-da.

The question arises: Did the Omaha regard Wa-kon'-da as a supreme being? There is no evidence that he did so regard the power represented by that word, nor is there any intimation that he had ever conceived of a single great ruling spirit.

Anthropomorphism.—The word Wa-kon'-da appears to have expressed the Indian's conception of immanent life, manifest in all things. Growing out of this conception was a kind of anthropomorphism; the characteristics of man were projected upon all nature: the rock, in the rituals, was addressed as 'Aged One!' sitting with 'furrowed brow' and 'wrinkled loins;' the tree lived a double life in the Indian's fancy; as did the water, the fire, the winds and the animals. This duality can be recognized in myths, in legends, in rituals, and in the paraphernalia of ceremonies, in which there is a constant confusion of the external aspect and the anthropomorphic conception. All things were distinct from man, but in the subtle bond of a common life, embodying the idea of will, or directive energy, they were akin to him, and could lend him the aid of their special powers, even as he could help or hinder his fellow men.

Will-power.—We trace the Omaha's estimate of his own will-power in the act called Wa-zhin'-dhe-dhe (wa-zhin, directive energy; dhe-dhe, to send), in which, through the singing of certain songs, strength could be sent to the absent warrior in the stress of battle; or thought and will be projected to help a friend win a game or a race; or even so to influence the mind of a man as to affect its receptivity of the supernatural. Aside from the individual practice of this power, there was, so to speak, a collective energy exercised by the Hon'-he-wa-chi society in the act of Wa-zhin'-a-gdhe (wa-zhin, directive energy; a-gdhe, to place upon), where the members so fixed their will upon an obnoxious person as to isolate him from all helpful relations with men and animals and leave him to die. A similar ability to aid or to injure was imputed to the elements and all natural forms. The winds could bring health to man; the stone insure him long life; the elk could endow the pursued with speed, and the hawk make the warrior sure to fall upon his enemy. But it is to be noticed that while man's own will was believed to act directly, without intervening instrumentality upon his fellows, the supplementing of

man's powers by the elements and the animals was obtainable only after an appeal to Wa-ẍon'-da, in the rite of the vision.

The Appeal.—The prayer, which formed a part of the rite of the vision, was called Wa-ẍon'-da gi-kon. Gi gi-kon' is to weep, from loss as that of kindred; the prefix gi indicates possession. Gi-kon is to weep from want of something not possessed, from conscious insufficiency, and the longing for something that could bring happiness or prosperity. The words of prayer, wa-ẍon'-da dhe-dhu wah-pa'-dhin a-ton'-he, literally rendered are: Wa-ẍon'-da here needy I stand. (A-ton-he is in the third person, and implies the first, as he stands, and I am he—a form of speech used to indicate humility.) While this prayer has been combined with many rites and acts, its inherent unity of name and words has been preserved through generations of varied experience and social development of the people.*

Wa-ẍon'-da was a vague entity to the Omaha, but the anthropomorphic coloring was not lacking in the general conception; the prayer voiced man's ever present consciousness of dependence, was a craving for help, and implied a belief in some mysterious power able to understand, and respond to his appeal. The response came in a dream, or trance, wherein an appearance spoke to the man, thus initiating a relation between them, which was not established until the man, by his own effort, had procured a symbol of his visitant, which might be a feather of the bird, a tuft of hair from the animal, a black stone or a translucent pebble. This memento or totem was never an object of worship; it was the man's credential, the fragment, to connect its possessor with the potentiality of the whole species represented by the form seen in his vision, and through which the man's strength was to be reënforced and disaster averted.

Basis of the Efficacy of the Totem.—The efficacy of the totem was based upon the Omaha's belief in the continuity of life, a continuity which not only linked the visible to the invisible, and bound the living to the dead, but which kept unbroken the thread of life running through all things, making it impossible for the part and the entirety to be disassociated. Thus, one man could gain power over another by obtaining a lock of his hair, which brought the man himself under his influence. In the ceremony of the first cutting of the child's hair, the severed lock, which was given to the Thunder god, placed the life of the child in the keeping of the god. Again, when a man's death had been predicted—by one gifted to see into the future—the disaster could be averted by certain ceremonies which included the cutting off of a lock of hair from one side of the head, and a bit of flesh from the arm on the opposite side of the body, and casting them into the fire; by this sacrifice of a part the whole was represented, the prediction fulfilled and the man permitted to live. From the ritual of the Corn, sung when the priest distributed the kernels to indicate that the time for planting had come, we learn that these kernels were the little portions which would draw to themselves the living corn. In the ritual sung over the Sacred Buffalo Hide prior to the hunt the same idea is present, that in the continuity of life the part is ever connected with the whole, and that the Sacred Buffalo Hide was able to bring within reach the living animal itself.

Limitation in Totems.—The totem opened a means of communication between man and the various agencies of his environment, but it could not transcend the power of its particular species; consequently all actions were not equally potent. Men who

*This prayer can be seen on page 136, Song No. 73, of Vol. 1, No. 5, of the Archæological and Ethnological papers on the Peabody Museum, Harvard University.

saw the Bear in their visions were liable to be wounded in battle, as the bear was slow of movement, clumsy and easily trapped, although a savage fighter when brought to bay. Winged forms, such as the Eagle, having greater range of sight than the creatures which traveled upon the ground, could bestow upon the men to whom they came in the dream the gift of looking into the future and foretelling coming events. Thunder gave the ability to control the elements, and the authority to conduct certain religious rites.

Despite the advantages to be derived from the possession of certain totems, the inculcations given when the youth was instructed in the rite of the vision, and taught the prayer he was to sing, forbade him to ask for any special gift, or the sight of any particular thing; he was simply to wait without fear, and to accept without question, whatever Wa-kon'-da might vouchsafe to send him. No man was able to choose his personal totem, but it was the general belief of the people that the powerful animals and agencies were apt to be drawn toward those who possessed natural gifts of mind and strength of will.

Nature of the Totems.—The totems of the Omahas referred to animals, the Bear, the Buffalo, the Deer, the Birds, the Turtle and Reptiles; to the Corn; to the elements, the Winds, the Earth, the Water and Thunder. There was nothing among them which in any way represented the human family, nor was there any trace of ancestor worship; the relation between the man and his totem did not lie along the line of natural kinship, but rested upon the peculiarities in his theory of nature, in which the will and ability to bring to pass, which he was conscious of within himself, he projected upon the universe which encompassed him. The rite of the vision was a dramatization of his abstract ideas of life and nature, and the totem was the representation of the vision in a concrete form.

THE SOCIAL TOTEM AND WHAT IT STOOD FOR IN THE TRIBE.

We have thus far seen the influence of the totem upon the individual. We are now to trace it as exerted upon groups of people; in the religious societies; in the Ton'-won-gdhon, or gens; and in the development and organization of the tribe.

Religious Societies.—The totem's simplest form of social action was in the religious societies, whose structure was based upon the grouping together of men who had received similar visions. Those who had seen the Bear made up the Bear society; those to whom the Thunder or Water beings had come formed the Thunder or the Pebble society. The membership came from every kinship group in the tribe, blood relationship was ignored, the bond of union being a common right in a common vision. These brotherhoods gradually developed a classified membership with initiatory rites, rituals and officials set apart to conduct the ceremonials.

The function of the totem in the societies was intermediate between that of the individual totem and the totem in its final social office, where it presided over an artificial structure, in which natural conditions were in part overruled and the people inevitably bound together. In some of the tribes of the linguistic group to which the Omahas belong, where the political structure of the gens is apparently weak and undeveloped, the religious societies exist and are powerful in their organization. This fact, with other evidence which cannot be detailed here owing to its complex nature, together with the similarity traceable between the rituals and ceremonies of these religious societies, and those incident to the inauguration of gentile and tribal officers, makes it seem probable that the

training and experience derived from the working of these earlier societies had taught the leaders among the Omahas and their close cognates certain lessons in organization, by which they had profited during the formative period of the artificial social structure of the Ton'-won-gdhon, or gens.

The Ton'-won-gdhon.—The word Ton'-won-gdhon means a place of dwellings where kindred dwelt together. There were ten Ton'-won-gdhon u-zhu—dominant, ruling Ton'-won-gdhon, or gentes, in the Omaha tribe. These gentes practice exogomy, and traced their descent only through the father. Each gens had its particular name, which referred directly or symbolically to its totem, which was kept in mind by the practice of tabu. There was also a set of names peculiar to each gens, all having the same reference, one of which was bestowed upon each child; an Omaha's gentile name, therefore, would at once reveal his kinship group or gens. This name was proclaimed at the time of the ceremony attendant upon the cutting of the first lock of hair. After this ceremony the child's hair was cut in a fashion to symbolize the totem of its gens, and each spring, until it was about seven years of age, this peculiar trimming of the hair was repeated. The teaching of this object lesson, so placed before the children, was reënforced by their training in the strict observance of the special tabu of their gentes, holding ever before them the penalties for its violation, of blindness, physical deformity and disease.

There were religious rites peculiar to each gens in which the members did homage to the special power represented by the gentile totem. In these ceremonies the hereditary chiefs of the gens were the priests. It is easy to see why the totem was never forgotten, why its sign was borne through life, and at last put upon the dead, in order that they might be at once recognized by their kindred, and not wander as they passed into the spirit world.

Office of the Totem in the Gens.—In the early struggle for existence the advantages accruing from a permanent kinship group, both in resisting aggression and in securing a food supply, could not fail to have been perceived; and, if the people were to become homogeneous and the practice of exogomy continue, some expedient must have been devised by which permanent groups could be maintained and kinship lines be defined. The common belief of the people, kept virile by the universal practice of the rite of the vision, furnished this expedient—a device which could be understood and accepted by all—the concrete sign of the vision, the totem of the leader, he whose abilities and prowess evinced supernatural favor and won for his followers success and plenty.

From a study of the minutiæ of the customs and ceremonies within the gens, it is apparent that their underlying purpose was to impress upon the people the knowledge and the duties of kindred, and that one of the most important of these duties was the maintenance of the union of the gens. This union of kindred we find to have been guarded by the agency of the totem. The name of the gens, the personal names of its members and the practice of tabu—obligatory upon all persons, except the hereditary chiefs, while they were officiating in the gentile rites pertaining to the totem—indicate a common allegiance to a supernatural presence believed to preside over the gens by virtue of its relation to the common ancestor. These rites did not imply ancestor worship, but were a recognition of the special power represented by the totem. We also find that the gentile totem did not interfere with a man's freedom in seeking his personal totem, nor of his use of it when desiring help from the mysterious powers. The gentile totem gave

no immediate hold upon the supernatural, as did the individual totem to its possessor; outside the rites already referred to, it served solely as a mark of kinship, and its connection with the supernatural was manifest only in its punishment of the violation of tabu. Briefly stated, the inculcation of the gentile totem was that the individual belonged to a definite kinship group, from which he could never sever himself without incurring supernatural punishment.

Social growth depended upon the establishment of distinct groups and the one power adequate for the purpose was that which was believed to be capable of enforcing the union of the people by supernaturally inflicted penalties. The constructive influence of the totem is apparent in the unification of the To*n*'-wo*n*-gdho*n*, or gens, without which the organization of the tribe would have been impossible.

The Influence of the Religious Societies upon the Gens.—In the religious societies the people were made familiar with the idea that a common vision could create a sort of brotherhood. This fraternity was recognized and expressed by the observance of rites and ceremonies, in which all the members took part, setting forth the peculiar power of the totem. The influence of this training in the religious societies is traceable in the structure of the gens, where the sign of a vision, the totem, became the symbol of a bond between the people, augmenting the natural tie of blood relationship in an exogamous group. We find this training further operative in the establishment of rites and ceremonies in honor of the gentile totem, which bore a strong resemblance to those already familiar to the people in the societies. In the gens the hereditary chief was the priest, and this centralization of authority tended to foster the political development of the gens.

Related Totems.—Certain fixed habits of thought among the Omahas growing out of their theories and beliefs concerning nature and life—upon which the totem was based—present a curious mixture of abstractions and anthropomorphism, blended with practical observations of nature. Thus, in the varied experiences of disintegration and coalescing during past generations, composite gentes came into existence through the supposed affinity of totems. Out of the ten Omaha gentes, three only observe a single tabu; the other seven were composed of sub-groups, called To*n*'-wo*n*-gdho*n* u-zhi*n*ga (u-zhi*n*ga, a small part), each of which had its own special tabu, obligatory upon its own members only, and not upon the other sub-groups of the gens. While there was no common totem in a composite gens, the totems of the sub-groups which formed such gens had a kind of natural relation to each other; the objects they symbolized were more or less affiliated in the natural world, as, for example, in the Mo*n*'-dhi*n*-ka-ga-*he* gens (the earth makers), where the totems of the sub-groups represented the earth, the stone and the animals that lived in holes in the ground, as the wolf.

The relation between the totems of composite gentes is not always patent; it frequently exists because of fancied resemblances, or from a subtle association growing out of conditions which have sequence in the Indian mind, although disconnected and at variance with our own observation and reason.

The Totem in the Tribal Organization.—The families within a gens pitched their tents in a particular order or form, which was that of a nearly complete circle, an opening being left as an entrance way into the the enclosed space. This encampment was called by the untranslatable name Hu'-dhu-ga. When the entire tribe camped together, each of the ten gentes, while still preserving its own internal order, opened

its line of tents and became a segment of the greater tribal Hu'-dhu-ga, in which each gens had its fixed unchangeable position, so that the opening of the tribal Hu'-dhu-ga was always between the same two gentes. Both these gentes were related to Thunder. That upon the right, as one entered the circle, was the In-shta'-thun-da —flashing eye—known as the Thunder gens or people. To a sub-group of this gens belonged the right of consecrating the child to the Thunder god, in the ceremony of cutting the first lock of hair; another sub-group kept the ritual used in filling the Sacred Tribal Pipes. On the left of the entrance camped the We'-zhin-shte—a symbolic name, probably meaning the representatives of anger. The We'-zhin-shte were Elk people, having in charge the Sacred Tent of War, in which the worship of Thunder, as well as all the rites pertaining to war, of which Thunder was the god, took place.

It would lead too far afield to follow at great length the inter-relations of the gentes; or the dominance of position and leadership in tribal rites and ceremonies conceded to certain gentes; or to indicate the scars left upon the Hu'-dhu-ga by the breaking away of groups of kindred; or the the devices used to keep intact an ancient form and order. The point to be borne in mind is that the position of the gentes in the tribe, and the interlacing of their functions, were regulated by the ascription of different powers to their totems, and that the unification and strengthening of the gens depended upon the restraining fear of supernatural punishment by the totemic powers.

In this rapid review of Omaha beliefs and customs connected with the totem, many observances have not even been mentioned; and of those indicated, the details have had to be omitted in order to keep strictly within the limits of our subject, but the fundamental ideas which have been briefly considered will be found to underlie all rites and ceremonies within the tribe.

Linguistic Evidence as to the Totem. — We turn now to the language for further evidence as to the import of the totem.

The name of the concrete sign of the vision is Wa-*hu*'-be, a sacred thing. The word is applied to sacred objects other than the totem, such as the Sacred Pole, the Sacred Tents, the Sacred Tribal Pipes, etc.

The name of a religious society always included the name of the manifestation of the vision of its members; for instance, the Bear society was called Wa'-tha-be i'-dha-e-dhe, literally rendered is: the Bear with or by compassion; that is, those upon whom the Bear had compassion. I'-dha-e-dhe implies that this compassion, this pity, was aroused by a human being making a personal appeal, either by his destitute appearance or the movable character of his supplication. Usage forbade the application of this word to any emotion excited by animal life; it could only express a feeling between man and man, or between man and the manifestation of Wa-kon'-da. It did not represent an abstract idea, as of a virtue, but a feeling awakened by direct contact with need. In the prayer already cited as a part of the rite of the vision the man makes a direct appeal to Wa-kon'-da ('Wa-kon'-da! here needy I stand'), and reference to this act is made in the employment of the word i'dha-e-dhe in the term designating the religious societies.

The name of a gens indicated its totem or the characteristic of the group of totems in a composite gens. When the people of a gens were spoken of in reference to their totem the word i'-ni-ka-shi-ki-dhe was used immediately following that of the totem; for instance, the Thunder people—the In-shta'-thun-da gens—were called In-gdhan-i'-ni-ka-shi-ki-dhe; in-gdhan', thunder: i'-ni-ka-shi-ki-dhe is a composite word,

meaning: they make themselves a people with; that is, with thunder they make themselves or become a people. The We'-zhi*n*-shte gens, the Elk people, were called O*n*-pa i'-ni-ka-shi-k̈i-dhe—o*n*-pa, elk; with the Elk they make themselves a people. The word i'-ni-ka-shi-k̈i-dhe clearly indicates the constructive character of the totem in the gens.

The set of names which belonged to each gens referred to the sign or totem of a family group; these names were called ni'-ki-e—spoken by a chief, or originated by a chief. The word ni'-ki-e points to the formative period when means were being devised to transform the family into a distinct political group; it argues a central authority, a man, a chief; the individual names which he bestowed allude solely to the power behind the chief, the manifestation of his vision represented by his totem, in the favor of which he and his kindred had made themselves a people, i'-ni-ka-shi-k̈i-dhe.

The Osage equivalent of the Omaha word i'-ni-ka-shi-k̈i-dhe is zho'-i-ga-ra, meaning associated with. The Otoe word used for the same purpose is ki'-gra-jhe, they call themselves.

The word for tribe u-k̈i'-ẗe, when used as a verb, means to fight, to war against outside enemies, indicating that the need of mutual help impelled the various To*n*'-wo*n*-gdho*n* (gentes) to band together for self-preservation; but the order of their grouping was, as we have seen, controlled by their totems.

Summary.—In the word for tribe, in the formation of the gens within the tribe, and in the rite which brought the individual into what he believed to be direct communication with Wa-k̈o*n*'-da, we trace the workings of man's consciousness of insecurity and dependence, and see his struggles to comprehend his environment and to bring himself into helpful relations with the supernatural. And we find in this study of the Omaha totem that, while the elements, the animals and the fruits of the earth were all related to man through a common life, this relation ran along discrete lines, and that, his appeal for help once granted, relief could only be summoned by means of the Wa-*h*u'-be, the sacred object, the totem, which brought along its special line the desired supernatural aid.

It is noteworthy that the totems of individuals, as far as known, and those of the gentes, represented the same class of objects or phenomena, and as totems could be obtained in but one way—through the rite of the vision—the totem of a gens must have come into existence in that manner, and must have represented the manifestations of an ancestor's vision, that of a man whose ability and opportunity served to make him the founder of a family, of a group of kindred who dwelt together, fought together and learned the value of united strength.

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*MULTIPLE-CYLINDER STEAM-ENGINE.**

The following is a very brief abstract of the paper presented to the American Society of Mechanical Engineers, by Messrs. Thurston and Brinsmade, at the last convention, New York, Deceber 2, 1897:

The paper was a statement of the results of the experimental investigation of the relative efficiency of standard forms of compound and triple-expansion engines and a newly introduced type in which the high-pressure cylinder is given about one-half the size ordinarily assigned for a stated power, as compared with the magnitude of the low-pressure cylinder. Remarkably

*Presented at the New York meeting (December, 1897) of the American Society of Mechanical Engineers, forming part of Volume XIX. of the *Transactions*.

high efficiencies had been reported and it had become important to ascertain what relation the new sustained to the old system. The machines employed in the research were, in fact, the available combinations of of the largest of the triple-expansion 'experimental engines' of Sibley College, and the combinations adopted were:

1. The triple-expansion engine in its usual condition.

2. The intermediate- and the high-pressure elements combined to make a compound engine of usual proportions—three to one.

3. The low- and the high-pressure elements combined to produce a compound of the peculiar sort above mentioned—seven to one.

Earlier reports upon the performance of engines of these several types had been made to the same Association and the results so reported had been as below; the second of the three cases illustrating the novel practice which it was here sought to study:

several types of engine. Taking the best performance of the ideal engine as varying as the logarithm of the pressure employed, as also found by experience to be approximately the fact with good engines, the gain to be fairly anticipated by adopting the higher pressure, other things being equal, should be such as to give the figures 11.8, 12.84 and 11.16 pounds of feed-water per horse-power per hour, for the three cases respectively. The relative efficiency will then be expressed by the figures 0.95, 0.87, 1.00. The engine of usual type, as a compound, when well-designed and built, thus gives a performance within 5 per cent. that of the best known triple-expansion engine; the compound, with exaggerated cylinder-ratio, lacks 13 per cent. of the efficiency of the triple-expansion and 7 per cent. that of the standard type of compound. Leavitt's Chestnut Hill engine, for which the figure 11.2 is reported, may be taken as identical with the Reynolds pumping engine in relative efficiency; correction being made for

CASE OF COMPOUND *vs.* TRIPLE AND INTERMEDIATE FORMS.

Engine.	Standard Compound.	Intermediate Form.	Triple Expansion.
Number of cylinders in series	2	2	2
Steam-pressure, absolute	151.6	175.5	135.5
Vacuum, in. mercury	27.75	25.3	27.6
Ratio of expansion	20.40	33. (nom.)	19.55
Revolutions per minute	18.57	76.4	20.31
Length of stroke, ft.	10.0	4	5
Piston speed, per minute, ft.	371.5	611.2	203
Cylinder-ratio	4	7	1, 3, 7
Drop between cylinders	None	14 lbs.	None
Dry steam, per I. H. P. per hr.	12.156	12.84	11.678
Difference favoring compound	0.684 lbs. = 5.3%		
Difference in favor of triple	0.478 lbs. = 4%	1.16 lbs. = 9%	
	a	*b*	*c*
St. cons. reduced to 175 lbs.	11.8	12.84	11.16
Comparative effic. on this basis	0.95	0.87	1.00

The table contains, in the last two lines, figures added to bring into more perfect comparison the relative economy of the difference in pressures. Were correction made for differences in ratios of expansion, the result above indicated would

have been somewhat more marked, as the engine of novel proportions has, nominally at least, 65 per cent. higher ratio than its rivals; but, as a considerable part of this apparent expansion-ratio measures free expansion without performance of work, the comparison on this basis would not be strictly correct. No correction is attempted for differences in speeds of piston or of revolution, on which score the intermediate type of engine would apparently have a very marked advantage; for, as was long ago pointed out by the writer, where jacketing is adopted successfully, variation of piston-speed seems to have little effect on economy.

The three experimental engines being compared, as proposed, and as indicated in the introductory paragraph, the novel proportions are found, in this case also, to give an efficiency intermediate between the standard compound engine and the standard triple-expansion under similar steam-pressures.

The following table shows the conditions during the most efficient periods of test of the three systems:

test of the triple and the most economical test of the 7-to-1 compound there is a difference of an inch and a half of mercury in the vacuum, and of four pounds in the boiler pressure. The column showing the three tests reduced to a common back-pressure was obtained by increasing or diminishing the mean effective pressure in the low-pressure cylinder of each by the amount each-varied in back-pressure from that of the required mean. In this case the mean was taken as the back-pressure in the triple-expansion test. This correction brings the triple and 7-to-1 compound nearer together, but we shall still have a difference in steam consumption of 1.48 pounds of steam per horse-power per hour between the triple and the 7-to-1 compound, and a difference of 2.1 pounds between the latter and the compound with the 3-to-1 ratio of cylinder volumes.

The performance, absolute and relative, of these three engines with varying power is illustrated in the accompanying diagram, which well exhibits the curious variation of relation, in this respect, produced by changing conditions of operation.

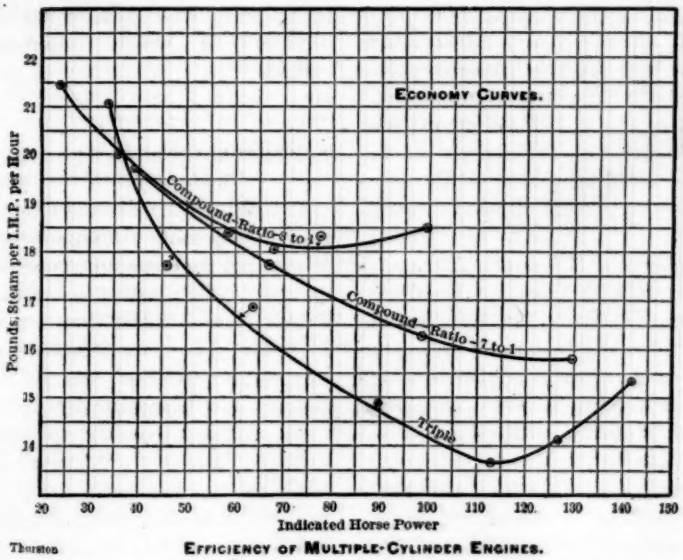
Comparison of the Most Economical Trials.

	Triple.	7-to-1 Compound.	3-to-1 Compound.
Boiler gauge	119.1	115	117.5
Revolutions per minute	84.95	87.65	85.52
Vacuum in inches of mercury	24.3	22.84	22.7
Condensed steam in pounds	1,205	1,753.7	1,030
Total jacket-water	335.4	316.7	190.97
Total steam used	1,540.3	2,070.4	1,221.2
Total I. H. P.	112.65	129.97	67.7
Distribution of work between cylinders, H. P. = 1	I. C. = 1 L. P. C. = 1	1.29	.635
Mechanical efficiency	84.1	86.6	90
Steam per I. H. P. per hour	13.68	15.8	18.03
Number of expansions	22	18.89	15.45
Steam per I. H. P. corrected to a vacuum of 24.3 inches mercury	13.68	17.1	17.3

It will be noticed that in the triple-expansion tests both the vacuum and the boiler pressure are better than in either of the others. Between the most economical

The curves in this figure leave no room for doubt in regard to the relative economy of the three engines. At about 37 horse-power the steam consumption in each case

is about the same. The curves then diverge, the 3-to-1 compound reaching a minimum steam consumption at 75 horse-power, of 18 pounds. The minimum points on the other curves, owing to their larger low-pressure cylinder volume, lie further along, and are 15.8 pounds for the 7-to-1 compound, and 13.7 pounds for the triple-expansion engine. We have thus a gain of 2.2 pounds of steam per indicated horse-power per hour of the 7-to-1 over the 3-to-1 compound, and a gain over the former by the triple-expansion engine of 2.1 pounds



Thurston EFFICIENCY OF MULTIPLE-CYLINDER ENGINES.

of steam per indicated horse-power per hour.

Comparing the best work of each type, as given by the records to the date of the preparation of this paper, the best work of good engines of each class may be taken as, approximately, measured by the weights of steam, per horse-power per hour, or by the number of thermal units, proportional to the reciprocal of the logarithm of the pressure adopted. Thus, the following are given as the relative efficiencies of these three engines, in terms of steam demanded, or of weight of feed-water consumed per horse-power per hour:

For the triple-expansion engine, $$W = \frac{24}{\log p} \quad (1)$$

For the standard compound, $$W = \frac{27}{\log p} \quad (2)$$

For the special form of compound, $$W = \frac{29}{\log p} \quad (3)$$

"The latter is seen, on examination of its proportions, to be a form of engine designed for an abnormally high total ratio of expansion at the proposed pressure, and assigned an abnormally heavy load; so that when actually in action under its average load it must work with a low ratio of expansion in the high-pressure cylinder, and must exhibit an abnormally large 'drop' at its exhaust."

The outcome of the investigation is that it is concluded that this novel, intermediate form of multiple-cylinder engine is also intermediate in its economical performance

between the standard compound and standard triple-expansion engines, sometimes so closely related to the latter that it becomes a question whether the third cylinder of the more complex machine may not be profitably dispensed with. This question will be answered in the negative or in the affirmative, apparently, accordingly as the costs of fuel are small or large, relatively to the costs of the possibly superfluous cylinder. With variable loads, also, the new type or proportion of engine is found to give indications of possessing some special advantages.

Referring to the principles which must control in any attempt to approximate more closely to the best possible thermodynamic employment of heat-energy, as transformed in the steam-engine, the following are given as the conclusions of the writers of the paper, as the essential guides of the engineer designing economical forms of steam-engine.

The Requisites of Maximum Thermodynamic Efficiency with Constant Load are:

(1) A steam distribution approaching most closely the ideal of Carnot; or, assuming the cycle of Rankine to be that in which the machine is constructed to act, the closest possible approximation to the ideal conditions of distribution for that cycle.

(2) As nearly as practicable, a non-conducting cylinder, or its equivalent, a non-heat-transferring working fluid, insuring, approximately, at least, adiabatic action, so far as heat transfers between working fluid and enclosing walls are concerned.

(3) Maximum possible range of pressure and temperature during expansion.

The Requisites for Maximum *Total* Efficiency are the above, together with:

(4) Minimum friction of engine and heat-losses.

(5) Limitation of the expansion-range by that volume at which the expansion line meets the line, parallel with the back-pressure line, marking the sum of the useless resistance of the machine *plus* that added quantity which is a fraction of the mean effective pressure equal to the ratio of the steam and heat wastes, internally and externally, due extra thermodynamic causes, to the total steam and heat supply.

The Requisites for Maximum *Commercial* Efficiency are, further:

(6) Such an adjustment of the proportions and of the steam-distribution of the engine that any change would cause a larger loss in the dividend account than would be saved by better conditions in the direction in which improvement was sought.

PREHISTORIC QUARTZITE QUARRIES IN CENTRAL EASTERN WYOMING.

In July, 1894, while our scientific expedition was passing through eastern central Wyoming, we came upon some prehistoric quarries, which, owing to their number and extent, are of more than usual scientific interest. They are located some forty or fifty miles north and east of Badger, a station on the Cheyenne and Northern Railroad, one hundred and twenty-five miles north of Cheyenne. There are no roads or trails leading to this discovery, but the old overland trail, following the north side of the North Platte River, passes some four or five miles west of the largest quarries. The drainage from the quarries is to the northward, into Muddy Creek, which flows westward to the Platte River. In the vicinity of the quarries the stream is dry, and water is found running only in the spring and during heavy rains. The country about is very arid, and there is but a scanty supply of both water and vegetation.

Passing through this region from the northeast to the southwest is a very prominent bluff, with precipitous slopes facing

the north. The bluff is five or six miles in length, and scattered along nearly its entire distance are the quarries of various sizes and shapes. The bluff has been caused by a fault which brought the Dakota sandstone to the surface. This sandstone has been metamorphosed into a great variety of quartzites. In color they shade from white to nearly black, and from a light pink to a dark red. They are very fine grained and work so easily by chipping that a novice can make a very good-looking implement in a few minutes.

In the preliminary examination, which was necessarily very limited, nineteen openings were visited. The nature of the openings varied so much that it has been thought best to classify them as follows: 1. Superficial; work of great surface extent where exposed blocks of quartzite have been dug up. 2. Shallow quarries; which are quite extensive, but have not been worked to a depth of more than two or three feet. 3. Deep quarries; worked to a depth, varying from fifteen to twenty feet or more. 4. Tunnels; but one of this class was seen. 5. Shafts; resembling the modern mining shaft, but not appearing to be very deep. All of the work has been done in a very systematic manner, and does not resemble the ordinary quarries so common in Wyoming, and from which the Indians secured most of the material to manufacture implements. In place of delving here and there, these quarrymen opened a quarry along the outcropping quartzite and worked it into the bluff, or dug a hole deep enough to reach the valued stone. In all the openings they had evidently maintained a clean face to work on. The refuse rock was carried back as by modern quarrymen. In fact, one could easily imagine that these quarries were old modern ones.

The largest quarries are located near the center of the bluff and near a very small spring. A description of the largest of this group will give a general idea of the excavations. It covers several acres of ground which slopes gently to the north and east. The workmen had commenced the excavation on a point, but when operations were suspended the quarry face was several hundred feet wide. The ground that has been worked over is covered with irregular mounds of refuse, which in the majority of cases is grass grown. In exposed places, where the wind has had free access, the refuse heaps are as the quarrymen left them. No fragments of rocks were seen that would make a heavy load for one man to carry. Near the old quarry face, which in most places was entirely obliterated, and where the fragments of rock have not been covered with the drifting sand, there were

FIG. 1.

numerous circular depressions. These had been made with rock fragments, and were from two to three feet in diameter and from twelve to sixteen inches in depth. Within these depressions were numerous roughly formed implements. These pits were beyond question collecting places for the quarrymen, and the pieces left behind were rejected on account of some defect. Near the old quarry face some enthusiastic prospector has in recent years sunk a shaft, probably in search of gold. This shaft, although partly caved, was nearly twenty feet deep. On one side rock in place could be seen, but the shaft had been sunk in the débris.

The implements found about the quarries were unusually large and rudely made. No finely finished implements of any kind were found. The hammers and mauls were all made from boulders of quartz and granite that had been brought from the neighboring mountains, some twenty miles away. With the exception of the mauls and hammers, all of the implements found were made of quartzite. Spear points, scrapers, axes and anvils were all of the implements found that have been classified. The axes are exceptionally rude, and according to Dr. Wilson, of the Smithsonian, are the first reported from the Rocky Mountains. Some three hundred implements were collected. For some distance about the quarries the ground was strewn with chips and fragments of quartzite, but in no instance were any heaps of chips and refuse, as are usually seen where the implement maker has labored.

There were no signs of any habitation except the tepee rings, which were scattered all around the quarries, in valley and on hill alike. No burial places were found. On the northeast slope, leading from the largest quarry, the workman left a very peculiar figure. It faces the east, and has been made by arranging fragments of rock along the ground. There were circular piles of stone at either end of the figure. (See Fig. 2.)

Fig. 2.—*aa*, piles of stones; *b*, circle; length about eighty feet.

The most striking points associated with these quarries are as follows: The vast amount of work done, the absence of chip heaps, the rude nature of the implements and their great size. All estimation of the tonnage of rock moved must be left for some future investigation. Suffice it to say that it will be estimated by the hundreds of thousands, if not by millions, of tons. The absence of chip heaps leads one to suppose that the quarrymen carried the quartzite away to manufacture. Which, if true, would signify that these quarries were neutral ground where the aborigines from all quarters worked for the implement stone, and that they took it to their respective haunts to work up. The unusual positions of many of the tepee rings also strengthens this supposition. Quartzite implements made from quartzite resembling that quarried from this region are very common on the plains and in the mountains. The rudeness of the implements can not be explained satisfactorily at this time. It might have been due to the age in which they were made, or it may be possible that only rejected implements have been found. The size is, no doubt, due to the nature of the stone. It would make a large implement, but possibly not a small one.

The quarrymen must have been the aborigines, but unlike the Indians of modern times, they must have been laborers, and have worked for centuries to have accomplished so much, with the very crude tools that they used. Who they were will never be known. The trails over which they traveled are entirely obliterated, and most of the quarries are covered with drift-

ing sand and overgrown with the scanty vegetation of an arid region.

Central eastern Wyoming is a very noted place for prehistoric quarries, but as a rule they are small and very shallow and are in no way comparable to the recent discovery. Usually the Indians have worked for jasper and agate and have dug irregular openings that do not represent systematic development. Quartzite quarries are extremely rare and these are by far the largest that have been reported from Wyoming.

WILBUR C. KNIGHT.

UNIVERSITY OF WYOMING,
LARAMIE, December 30, 1897.

ASSOCIATION OF AMERICAN ANATOMISTS.

UPON the invitation of Cornell University, the Association met at Ithaca, N. Y., December 28–30, 1897. Morning and afternoon sessions were held on each of the three days excepting Wednesday, when all the affiliated societies met in the afternoon with the American Society of Naturalists. Notwithstanding the small attendance the sessions were fully occupied with reports, papers and discussions, and several papers were read by title for lack of time.

After a brief introductory by the President, Dr. Frank Baker, Dr. B. G. Wilder read an obituary notice of Dr. Harrison Allen, one of the founders and Presidents of the Association. The report of the Secretary-Treasurer, Dr. Lamb, showed that there were 105 active and 4 honorary members. Dr. Allen, and Dr. Wm. Laurence Dana, of Portland, Me., had died and Dr. P. J. McCourt, of New York City, had resigned. Beginning with the present year the annual dues are three dollars.

The circular and blanks in reference to the anatomical peculiarities of the negro race were ordered to be modified and copies sent out for report of cases.

The Association adopted the report of the majority of the Committee on Anatomical Nomenclature, and ordered it to be published and distributed as soon as practicable, accompanied by the objections of the minority of the Committee, and comments thereon by the Secretary of the Committee. Of the neural terms recommended, more than 100 were identical with those adopted in 1895 by the Anatomische Gesellschaft.

The following papers were read and discussed; they were illustrated by specimens, photographs and diagrams:

Dr. P. A. Fish, Ithaca, N. Y.: 'A fluid for the retention of natural colors of anatomical specimens' and 'Mummification of small anatomical specimens.'

Dr. George S. Huntington, New York City: 'Comparative anatomy and embryology as aids to the teaching of human anatomy in the medical course.'

Dr. B. G. Wilder: 'An adult and healthy living cat, lacking the left arm, excepting the scapula and having the heart apparently at the epigastrium.'

Dr. Woods Hutchinson, Buffalo, N. Y.: 'Relative diameters of the human thorax.'

Dr. D. S. Lamb, Washington, D. C.: 'Pre-Columbian syphilis.'

Mr. Charles H. Ward, Rochester, N. Y.: 'A craniomandibular index.'

Professor Howard Ayers, University of Missouri: 'The membrana basilaris, membrana tectoria and nerve endings in the human ear.' Read by Dr. Hopkins.

Dr. Wilder: 'Certain resemblances and peculiarities of the human brain.'

Dr. B. B. Stroud, Ithaca, N. Y.: 'The ape cerebellum.'

Dr. Fish: 'The brain of the fur-seal, *Callorhinus ursinus*.'

Dr. Huntington: 'The eparterial bronchial system of mammalia.'

Dr. J. A. Blake, New York City: 'The relation of the bronchi to the thoracic wall.'

Dr. Thomas Dwight, Boston, Mass.: 'The distribution of the superior mesenteric artery.' Read by Dr. Lamb.

Dr. D. W. Montgomery, University of California, San Francisco: 'Sebaceous glands in the mucous membrane of the mouth.' Read by Dr. Lamb.

Dr. Stroud: 'Notes on the appendix.'

Professor S. H. Gage, Ithaca, N. Y.: 'On the relation of the ureters in the cat to the great veins, with variations.'

Dr. Wilder: 'A number of specimens of either unusual or specially instructive character.'

Mr. H. A. Surface, Fellow in Cornell University: 'Notes on the fish fauna of Cayuga Lake.'

The following papers were read by title:

Professor George A. Dorsey, Chicago: 'Description of two Koutenay skeletons' and 'Two examples of unusual ossification of the first costal cartilages.'

Dr. E. R. Hodge, Washington, D. C.: 'Relation of sex to the size of the articular surfaces of the long bones.'

Dr. J. T. Duncan, Toronto, Canada: 'Anus vulvalis.'

Dr. Woods Hutchinson: 'A skin heart.'

The following officers were elected for the ensuing term: Dr. B. G. Wilder, Ithaca, N. Y., President; Dr. Geo. A. Piersol, Philadelphia, First Vice-President; Dr. William Keiller, Galveston, Texas, Second Vice-President; Dr. D. S. Lamb, Washington, D.C., Secretary and Treasurer.

Dr. F. J. Brockway, of New York City, Delegate, and Dr. R. W. Shufeldt, of Washington, Alternate, to Executive Committee of Congress of American Physicians and Surgeons.

Dr. F. J. Shepherd, of Montreal, Canada, member of the Executive Committee of the Association, in place of Dr. Huntington, term expired.

The following eminent anatomists of the Old World were elected honorary members: Dr. Mathias Duval, Paris; Dr. Carl Gegenbaur, Heidelberg; Dr. Wilhelm His, Leipzig; Dr. Albert von Kölliker, Wurzburg; Dr. Alexander Macalister, Cambridge; Dr. L. Ranvier, Paris.

It is understood that the next meeting will be held in New York City, in the Christmas Holidays, in conjunction with the Society of Naturalists and other affiliated societies.

D. S. Lamb,
Secretary.

CURRENT NOTES ON ANTHROPOLOGY.

SOUTH AMERICAN ETHNOGRAPHY.

The praiseworthy industry of linguists in South America is rapidly dispelling the uncertainty which has so long hung over the affiliations of tribes in that continent. Their recent labors merit a much fuller notice than can here be given, but they must at least be named.

Two articles by Samuel A. Lafone Quevedo deserve especial mention. One is, indeed, a volume of nearly 400 pages, with map, etc., on the tongue of the Abipones (in the Boletin of the National Academy of Cordoba, Vol. XV.); the other is on the dialects of the Chanases and their neighbors (in the Boletin of the Geog. Inst., Tom. XVIII.). Both are excellent pieces of work.

Dr. Rodolfo Lenz has continued his thorough investigations of the Araucanian idiom by a series of pieces in the Pehuenche and a number of songs in that and the Moluche dialects (in the Anales of the University of Chile, Tom. XCVII.); and an instructive popular lecture on Araucanian literature, printed in the *Revista del Sur*.

A very fine monograph, ethnographic and linguistic, is that on the Matacos by Juan Pelleschi (pp. 248, with two maps, printed in the Boletin of the Geographical Institute, Buenos Aires). It is accurate, original and exhaustive.

LIVING TRIBES IN THE STONE AGE.

In a few remote corners of the earth there are yet tribes in the full Stone Age, living under the conditions of early neolithic man in Europe. Von den Steinen found such at the head waters of the Xingu; the Jesuits not long ago discovered such in the interior of Alaska; and a report has lately been published by the La Plata Museum of the Guayaquis, who dwell in Paraguay, near the head waters of the River Acaray, and who are alleged to be true Stone Age people. They are not over 500 or 600 in all, and are a timid, harmless set, shunning the whites from whom they have never received anything but brutal treatment. Their arms are the bow, the lance and the stone toma-

hawk. They wear tall caps of tapir skin and adorn their necks with strings of bones and teeth. They are somewhat undersized, prognathic and brachycephalic.

Strange to say, their language was not studied, the small vocabulary given, which is Guarani, being probably a blunder. Dr. Ehrenreich, from whose article in *Globus* I borrow the notice, inclines to believe them allied to the Botocudos.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

THE act of incorporation of the Washington Academy of Sciences states that its object is the promotion of science with power:

a. To acquire, hold and convey real estate and other property, and to establish general and special funds.

b. To hold meetings.

c. To publish and distribute documents.

d. To conduct lectures.

e. To conduct, endow or assist investigation in any department of science.

f. To acquire and maintain a library.

g. And, in general, to transact any business pertinent to an academy of sciences.

The nucleus of 75 members elected by the Joint Commission held the first meeting of the Academy on February 16th, when officers were elected as follows: *President*, J. R. EASTMAN; *Secretary*, G. K. GILBERT; *Treasurer*, BERNARD R. GREEN; *Managers*, Alexander Graham Bell, Frank Baker, F. W. Clarke, C. Hart Merriam, H. S. Pritchett, George M. Sternberg, Charles D. Walcott, Lester F. Ward and Carroll D. Wright. The seven Vice-Presidents will be nominated by the seven affiliated societies—Anthropological, Biological, Chemical, National Geographic, Geological, Entomological and Philosophical. The nucleus of 75 will probably be considerably enlarged at the next meeting by the addition, as original members, of persons nominated by a committee appointed for that purpose at the last meeting.

THE New York Academy of Sciences held its annual meeting on February 28th, when the retiring President, Professor J. J. Stevenson, made an address on 'The World's Debt to Pure Science.' The following officers for the ensuing year were elected: *President*, HENRY F. OSBORN; *1st Vice-President*, NATHANIEL L. BRITTON; *2d Vice-President*, JAMES F. KEMP; *Corresponding Secretary*, RICHARD E. DODGE; *Treasurer*, CHARLES F. COX; *Librarian*, ARTHUR HOLLICK.

THE New York Zoological Society has secured the $100,000 needed to enable it to take possession of the site provided by the city for a Zoological Garden. The total amount subscribed is $103,550. There have been thirteen $5,000 subscriptions by Levi P. Morton, W. K. Vanderbilt, Oswald Ottendörfer, Percy R. Pyne, William E. Dodge, Robert Goelet, J. Pierpont Morgan, Jacob H. Schiff, William D. Sloane, William C. Whitney, C. P. Huntington, Henry A. C. Taylor and George J. Gould. According to the terms of the agreement between the Society and the city, as effected last year with the Commissioners of the Sinking Fund, the Society is under obligation to raise $250,000 for buildings and collections, of which sum $100,000 must be in the Society's treasury on or before March 24, 1898, and it was agreed that the Society could not take possession of the site until that amount had been provided.

WE regret to learn that Professor W. A. Rogers, the physicist, is dangerously ill.

DR. RUDOLF LEUCKART, professor of zoology at Leipzig, died on February 7th at Leipzig, at the age of seventy-four years.

WE also regret to record the death of Professor Knud Styffe, Director of the School of Technology at Stockholm, and of M. P. B. L. Verlot, the botanist, at Verrières-les-Brusson.

THE Paris Academy of Sciences has passed resolutions expressing regret at the death of the publisher Jean-Albert Gauthier-Villars and their appreciation of the value to science of his services in publishing works such as those of Lagrange, Fermat, Fourier, Cauchy and others.

IT wished to raise by international subscription a fund for a memorial to the late Edmund Drechsel, the eminent physiological chemist, and for the education of his two sons. Subscriptions may be sent to Professor Kronecke, University of Berlin.

A MEMORIAL will be erected in the chemical laboratory of Bonn to August Kekulé, who for

nearly thirty years was professor of chemistry at Bonn. Contributions may be sent either to the Treasurer of the German Chemical Society, Dr. J. F. Holtz, Müllerstrasse, Berlin, N.

THE will of the late Dr. Harrison Allen bequeathes his valuable collection of mammals to the Academy of Natural Sciences of Philadelphia.

DR. E. C. SEGUIN, the pathologist and neurologist, who died recently in New York, has, by his will, given his instruments and books to Columbia University and the New York Academy of Medicine.

WE learn from *Nature* that the German Emperor, as King of Prussia, has conferred upon Dr. John Murray, Director of the Scottish Marine Station, and formerly of the *Challenger* expedition, the rare distinction of knighthood in the Order *Pour le Mérite*, founded by Frederick the Great. This is generally allowed to be the highest honor which a man of science can receive, and is limited to thirty German and twenty-five foreign knights. Lord Kelvin, Lord Lister and Sir G. G. Stokes are the only other British men of science now alive who have received the Order. Dr. Murray has also been elected a Foreign Member of the Imperial Russian Academy of Sciences.

M. FRANCHET has been elected President of the Botanical Society of France.

IN connection with the completion of his 25th year of office as Woodwardian professor of geology at Cambridge, it was proposed to present Professor T. M'Kenny Hughes with an illuminated address, to be presented at a public dinner held in London on the 26th of February. Sir Archibald Geikie has consented to preside.

PROFESSOR O. MATTIROLOT has been appointed Director of the Botanical Garden and Museum of Florence.

THE tenth Congress of Russian Men of Science and Physicians will be held at Kieff from August 21st to 30th, under the presidency of Professor J. Rachmaninow.

THE third Congress of the Italian Geographical Association will meet at Florence, beginning on April 12th. The quarter centenary of the discoverers Toscanelli and Vespucci will be celebrated as part of the proceedings of the Congress.

THE twenty-seventh Congress of the German Surgical Society will be held in Berlin, from April 13th to 16th, under the presidency of Professor Trendelenburg, of Leipzig. In connection with the Congress there will be an exhibition of preparations, instruments, etc., and a display of Röntgen photographs.

AN International Congress on Commercial Education will be held at Antwerp on April 14th–16th, with the Belgian Ministers of Foreign Affairs and Industry as Honorary Presidents. The Congress is especially designed to give to business men, to teachers of commercial subjects, and to representatives of central and local educational authorities, an opportunity of discussing the curriculum and methods which should be adopted in commercial schools of different grades. Further information can be obtained from the Secretary of the Congress, Monsieur Emile Roost, 120 Boulevard Léopold, Antwerp.

PRESIDENT MCKINLEY has appointed and commissioned J. W. Collins, of Massachusetts, to represent the United States at the International Fisheries Exposition, to be held in Bergen, Norway, from May to September of this year.

THE 51st annual meeting of the Institution of Mechanical Engineers was held recently in the hall of the Institution of Civil Engineers, Great George Street, Westminster. The chair was occupied during the earlier portions of the proceedings by Mr. E. W. Richards, the retiring President, who introduced Mr. Edgar Worthington, the newly-elected Secretary, to the meeting. The report stated that at the end of last year the number of names on the roll was 2,496, as compared with 2,359 at the end of the previous year. During 1897 227 names were added, the loss by death being 30, and by resignation or removal 60. The receipts during the year were £7,656, and the expenditure £6,202. The total investments and other assets amounted to £72,329, and after deducting therefrom £25,000, due on debentures and other sums, the capital amounted to £44,229. It was proposed to hold this year's summer meeting of the Institution at Derby. The result of the ballot for the

election of the Council was announced, Mr. S. W. Johnson being elected President, and Mr. Arthur Keene and Sir William White, Vice-Presidents.

A MAGNETIC observatory with an excellent equipment has been recently fitted up in the Parc Saint-Maur, Paris. But M. Mascott was compelled to announce recently at the Paris Academy that the City Council had given permission to an electric railway to pass near the observatory, which will entirely destroy its usefulness.

Nature states that on December 18, 1897, a hall was opened at Bologna for the reception of the herbaria, preparations and sections of the botanist Aldrovandi. It has been erected at the cost of the city and province.

THE bacteriological laboratory established in Constantinople by Pasteur at the request of the Sultan has been reopened after a period of neglect. This action has been taken after protests by the Imperial Society of Medicine and the French Chargé d' Affairés. It is said that the work of the laboratory will now be extended under Dr. Nicole.

MME. EMILE DURAND has given $7,500 to the Pasteur Institute for the purpose of making further researches on tuberculosis. The donation has been accepted.

THE weekly mortality for the plague at Bombay is now over 1,000, while the total number of deaths is over 2,000. The rate of the city is 120 per thousand inhabitants.

THE item in the Sundry Civil Appropriation Bill under consideration at Washington provides $520,000 for the representation of the United States at the Paris Exposition of 1900. Germany proposes to spend about $1,250,000, and the English government has announced its intention of asking an appropriation of $375,000. A Royal Commission to provide for the representation of Great Britain has been appointed, which includes Lord Kelvin, Lord Lister, Sir John Lubbock and other men of science.

AN amendment to the Sundry Civil Service Bill authorizes the holding of a National Exposition of American Products and Manufactures, especially suitable for export, in Philadelphia in 1899. The amendment carries an appropriation of $350,000, of which $300,000 is to be used to provide buildings for the Exposition and the remaining $50,000 to be expended in collecting exhibits.

THE party that has been collecting specimens of natural history in the Galapagos Islands, on behalf of the Frank Blake Webster Company, of Hyde Park, Mass., have returned, having, it is said, secured valuable collections.

THE *Publisher's Weekly* gives details of the books published in the United States during 1897. The number of new books was 4,171, being 1,018 fewer than in 1896. The decrease has been especially noticeable in fiction, belles-lettres and political science. There was, however, an increase in 'physical and mathematical science,' which apparently includes the natural sciences, the number of new books being 166, as compared with 136 in 1896.

THE F. A. Stokes Company will publish in April an account of Lieutenant Peary's seven arctic expeditions.

THE *Osprey*, the first volume of which was published at Galesburg, Ill., has been removed to New York City, the offices being at 141 East 25th Street.

THE Maryland State Historical Society was organized at Baltimore on January 26th, and the following officers were elected: President, Charles G. Biggs, Sharpsburg; Vice-President, Captain R. S. Emory, Chestertown; Secretary and Treasurer, James S. Harris, Kent county. Vice-Presidents were chosen by the delegates from the twenty-three counties of the State, thus giving a complete representation. A Legislative Committee, composed of J. P. Blessing, C. L. Rogers, E. A. Pry, Henry Brown and W. A. Shipley, was authorized to petition for an appropriation of $500 annually to aid in its work. The first business to come before the organization was the report of the Legislative Committee appointed by order of the convention. The chief recommendations of the report were as follows: "To provide for the formation of a Maryland State Horticultural Department; to protect the horticultural interests of the State of Maryland in the suppression and ex-

termination of the San José scale, peach yellows, pear blight and other injurious insect pests and plant diseases, and to create the offices of State Entomologist, State Vegetable Pathologist and State Horticulturist, and to appropriate a sum of money therefor. The professors of entomology, vegetable pathology and horticulture of the Maryland Agricultural College and the Experiment Station shall be the State officers and the department shall be under the control of the State Agricultural College, to whom the State officers shall be responsible. Notice, in writing, of infection is to be given to owners, and if not attended to after ten days the State officers shall act and the cost be added to the tax bill and collected as is other taxation. All nurseries of the State are to be inspected at least once in six months, and where found apparently free from insect pests and disease the owners shall be given certificates to such effect. Both Entomologist and Pathologist must make an annual report of inspection to the Governor of the State, this to be published as a Bulletin of the Experiment Station. The appropriation asked for carrying this into effect is $8,000 for the first year and $6,000 for each year after. Attention was also called to the 'clause' in the Game Law, which will permi boys to shoot robins, larks, doves and flickers at any time, and a resolution was unanimously adopted that 'members of the State Legislature be invoked to reject that section of the resolution which refers to these birds;' also, that the insectivorous birds shall be named, and their being killed or offered for sale shall be counted a misdemeanor and made punishable by fine."

The Electrical World gives a summary of a report in the *Elektrische Zeitschrift* of the work in electricity of the German Reichsanstalt during the past two years. Much work was done in connection with the standard ohm, and this may now be considered concluded, the determination of the ohm for that institution being now assured. Comparisons were made to determine the constancy of the wire and mercury secondary standards; these have been repeatedly compared, and gave very good results, as before; those of wire are almost all of manganin and show that this material, besides having a very small temperature coefficient, has a very good constancy, and is therefore well suited for exact measurements. Under standard cells it is stated that both the Clark and Weston cells were carefully examined, and the previous results were confirmed that the cells are constant and reproducible to 1 in 10,000; the dependence of the voltage of the cadmium cell on the composition of the amalgam was also investigated, also the effect of warming the cells. An absolute determination of the Clark cell was made with the Helmholtz electro-dynamometer, it being a repetition of the previous one; the results differed by less than 1 in 1,000 from the values obtained with the silver voltameter and showed that the absolute measurements of current agreed with those made by other methods. The determination of the E. M. F. of the Clark cell with the silver voltameter showed the difficulties involved, and if these are not taken into account the results are uncertain to 1 in 1,000. The magnetization of iron and steel in weak fields was investigated, and with annealed and hard cast steel and with cast iron a straight line relation was found, while for hard and soft wrought iron the relation was not so simple. The electric conductivity of solutions was also examined, and the results show that the electric current is very suitable for scientific research with solutions and in chemistry, being in some respects superior to other methods in analyses.

UNIVERSITY AND EDUCATIONAL NEWS.

University Day at the University of Pennsylvania, annually celebrated on Washington's Birthday, was this year the occasion of an address by President McKinley, who reviewed the services of Washington to the nation and to education and the importance of education to national life.

Commemoration Day was also celebrated at Johns Hopkins University on Washington's Birthday. In the course of an address President Gilman said that, in accordance with the wishes of many of its friends and supporters, taxpayers and citizens of Maryland, the Johns Hopkins University has decided to present a statement of its financial condition to the Legislature of Maryland to ask for State aid. Through the failure of the Baltimore and Ohio

Railroad, as is well known, the University has lost an income of $150,000 from funds invested in the railroad by the late Johns Hopkins. The sum of $250,000, $50,000 per annum, has been subscribed by friends of the University, but in spite of this the University is seriously hampered by the loss of its former income.

THE new building erected for the Ohio University at Athens has just been completed. It is a T-shaped structure, having a front of 156 feet and a depth of 131 feet. It contains an auditorium capable of seating about nine hundred persons; a gymnasium having a floor space of three thousand feet; a physical and electrical laboratory, a number of recitation rooms, offices, music-rooms, etc. The Ohio University is the oldest institution for higher education in the Northwest Territory, having been chartered in 1804. The main building, which is still in use, was erected in 1817. Ohio has now four universities, all of which have been provided by the Legislature with a permanent income.

COLBY University will begin at once the erection of a chemical laboratory to cost not less than $30,000.

THE Alumnæ Association of Bryn Mawr College has presented the College with $8,000 for a scholarship as a memorial to the first President of the College, the late Dr. James E. Rhodes.

DR. CHARLES DE GARMO, President of Swarthmore College, has been elected professor of the science and art of education at Cornell University. At the same University Professor H. W. Hibberd, of the University of Minnesota, has been elected assistant professor of railway engineering.

DR. H. EBERT, of Kiel, has been appointed professor of physics at Munich.

M. JENVRESSE has been appointed professor of industrial and agricultual chemistry in Besançon, M. Dubois associate professor of chemistry at Claremont, and M. Matignon lecturer in mineralogical chemistry at Lille, filling temporarily the chair vacant by the death of M. Joli.

AN anonymous donor has offered £10,000 for the extension of the buildings of Aberdeen University on condition that the government grant £20,000 for this purpose. It is expected that the town will also assist.

DISCUSSION AND CORRESPONDENCE.

BREVITY IN CITATIONS.

TO THE EDITOR OF SCIENCE: In one small matter, at least, the bibliographical reform which is making great strides has as yet failed to produce any improvement over past conditions. And it is not in the spirit of criticism, but in the hope that needed relief may be afforded, that public attention is hereby called to this item.

All authors who devote that care to bibliographical citations which is desirable give an exact statement of the volume, pages, plates, etc., for each paper or work to which reference is made; and one might well wish that this were at times more general, especially where an entire half day has been devoted to the search of a loosely quoted passage which happens to be essential to the point in mind. No one would desire to limit or in any way discourage this practice, but there is one feature that seems to be a waste of space, time and energy—namely, the endless repetition of the words volume, number, part and page, or their equivalent in some other language. Even in the usual abbreviated form in which such words appear they mean, in the aggregate, not a little space and time to both author and publisher. I am aware that individuals have endeavored more or less consistently and sometimes successfully to abandon them, but despite this the words continue to be generally used. Is this not largely because there has been no agreement as to the form a citation shall take, and, consequently, some uncertainty as to the interpretation of the reference, which causes the careful student to hesitate in introducing a system that may trouble or mislead his readers.

Our botanical confrères adopted in 1895, at the Madison Botanical Congress, a set of rules for citation which appear in every way admirable. They are clear, concise and seemingly complete, and the saving in their use is evident from the examples given. I have no means of knowing how generally they have been adopted by botanists, even in this country, and it is, of course, questionable whether they would be in-

troduced by the investigators and writers of other countries for evident reasons. To be permanently valuable to science, and to effect for the world a real saving, such measures must needs be international in character.

The admirable cards of the International Bibliographical Bureau at Zürich still continue to add in abbreviated form the words referred to above. Some such rules as those adopted by the Botanical Congress could be promulgated by the Bureau, with the hope that they would be generally understood and in time generally adopted. Am I wrong in believing such a movement for simplicity and uniformity in citation (1) desirable, (2) possible, (3) most likely to succeed under these circumstances?

Henry B. Ward.
University of Nebraska.

SCIENTIFIC LITERATURE.

Pflanzenphysiologie, ein Handbuch der Lehre vom Stoffwechsel und Kraftwechsel in der Pflanze. Zweite völlig umgearbeitete Auflage. Dr. W. Pfeffer. Leipzig, Wilhelm' Engelmann. 1897. Erster Band. Stoffwechsel.

It is safe to say that no handbook of plant physiology has yet appeared which, for comprehensiveness and breadth of treatment, keen criticism of conflicting researches, truthfulness of perspective, accuracy of detail and logical delimitation of the subject and its branches can be compared to Pfeffer's encyclopedic work, which now comes to the second edition. Perhaps no greater tribute to the merit of this great work and the master mind that planned it can be given than the fact that, after sixteen years of the most productive research in the history of botany, the author does not find it necessary to alter his method of treatment, although the establishment and development of many important principles have taken place in this period. The first volume is devoted to chemical physiology, and the second, now in preparation, to physical physiology, or phyto dynamics. The treatment is strictly inductive, with no lapses into speculation, or leanings toward vitalism, and, moreover, all the subjects included are fairly physiological, but scant discussion being given to ecological adaptations, though the method of variation is necessarily pointed out. The ten chapters of the first volume, now at hand, discuss the province of physiology, the nature of irritability, variation and hereditary, morphological-physiological considerations, swelling and molecular structure, mechanism of interchange of matter, mechanism of interchange of gases, the movements of water in the plant, nutrition, organization and energy of metabolism, respiration, fermentation and translocation. The contents of the separate chapters afford a ready appreciation of the development of the subject from 1881 to 1897, a record of progress in which Dr. Pfeffer and his students have taken an important part. The keen critical faculty of the author has enabled him to express clearly the condition of important questions yet in controversy, and, throughout the entire volume, generous and just estimate is made of the work of physiologists outside of Germany.

The author does not accept the term 'Energid,' of Sachs, as the physiological unit, and finds that 'cell' or 'protoplast' is still useful in that capacity. Barymorphose, photomorphose, etc., by the same author, are shown to be inapplicable to the influence of external agencies upon form and development. The foam structure of protoplasm, as described by Butschli, finds place in the discussion of the composition of protoplasm. Cilia and vacuoles are described as organs which may arise *de novo*, while no decision is reached as to the much harassed centrosome question.

Full place is given to recent researches showing the invariable connection between nuclei and the formation of wall membranes, and the facilities afforded for the translocation of plastic material, as well as of the protoplasm itself by means of the interprotoplastic threads, is pointed out. A new lease of life is given this theory by the adduction of evidence from recent researches that such substances as the oils are known to pass membranes in a finely divided condition.

The micellar theory of Nageli is used as a basis of the discussion of molecular structure, although the enlargement of the section devoted to this subject is due to collection of detail rather than development of principles involved.

The mechanics of absorption, excretion and secretion, diosmotic and osmotic properties of the cell with regard to fluids and gases have received such numerous and important additions that it would be possible to point them out only by recounting the summaries of the sections, which space does not permit, but much of the author's own work is briefly summarized here for the first time.

This is the first general text issued since the researches of Boehm, Askenasy, Strasburger, Schwendener, Dixon and Joly upon the ascent of sap were published, and the Jaminian chain, the intermittent activity of living cells, the lifting power of transpiration and the tensile strength of water are alike shown to be incompetent to account for the facts. Professor Pfeffer believes that whatever the impelling force may be, and the participation of living cells is not barred, the path of the current lies through the tracheal lumina and pits.

Transpiration is recognized as a necessary means for the distribution of the mineral elements in the plant, as a facilitation of gas diffusion, as a regulator of temperature, and the surmise is hazarded that it also may exercise a general tonic effect necessary for the maturity and welfare of the plant. A clear presentation of the relation of stomatal, cuticular and lenticular transpiration is made, as well as of the factors influencing these processes and the principal adaptations.

Bleeding and the phenomena of root-pressure are held to be due to the active secretory agency of living cells, in the root and stem, though plasmolytic agencies, as in nectaries may sometimes play a part in the process; and no essential difference from 'guttation' is exhibited. The water-pores and hyathodes of plants in moist localities may provide an outlet for water to maintain the upward stream, impossible by transpiration.

The chapter on nutrition contains 168 pages, in which all of the more important literature of the subject finds place, and it is impossible in the limits of this review to cite even a majority of the new and modified points of view given. In the consideration of the general metabolic activity of the organism all material is divided into three groups, viz.: constructive substances in the permanent structure of the organism, plastic substances capable of participation in the metabolic processes, and aplastic substances incapable of being used further in the nutrition of the organism. The last group naturally overlaps the first named.

Assimilation is used in the broadest sense to denote all physiological processes, or progressive chemical metamorphoses by which plastic or trophic substances are built up. According to the source of energy specific processes are designated as 'Photosynthese,' 'Chemosynthese,' 'Electrosynthese,' etc.

By photosynthesis is meant the formation of plastic material from carbon compounds, CO_2, (possibly $COCL_2$, COS, CO $(NH_2)_2$,) and water by the agency of the chlorophyll apparatus and sunlight, a sense in which it has been used by the reviewer since 1894, though not in agreement with the proceedings of the Madison Botanical Congress. (See editorial review, Botanical Gazette, Vol. 19, p. 341. 1894.)

Professor Pfeffer points out that the relation of chorophyll to the ground substance of the chloroplast is unknown, that the optical extinction of portions of the spectrum may or may not be coincident with photosynthetic activity, and that the intermediate steps in the formation of carbohydrates in this manner are unknown. The recent results of investigation upon the independent action of chloroplasts are detailed.

The nitrobacteria are instanced as the only organisms having the power of formation of carbohydrates from CO_2 by synthetic methods and by means of chemical energy.

The author distinguishes between saprophytic and symbiotic nutrition, using the former term only in connection with plants which take up organic food unaided. According to this classification the only seed-forming plants truly and entirely saprophytic are confined to a single genus. With regard to the general relation to organic food, plants are allotropic, mixotropic or autotropic. The results bearing upon the acquisition of nitrogen are brought together in orderly array, but our information on this phase of nutrition is at best very incomplete.

The discussion of the metabolic changes in the organism is enriched by the addition of an enormous mass of detail, yet it is to be said that

the diagram of chemical activities is largely suppositious, and that substances may be located here and there, with no indication decisive of synthetic or analytic origin.

The author includes many energy liberating processes under respiration, whether attended by excretion of CO_2 or not, and emphasizes the fact that it is only a link in the chain of metabolic metamorphoses. It is, therefore, not always possible to determine the subjects or products of respiration.

A comparison of the editions of 1881 and 1897 reveals the fact that Professor Pfeffer no longer deals with the organism as a purely chemical and physical machine, but regards it from a physiological point of view. Nowhere is this more vividly apparent than in a paragraph dealing with translocation, which is freely translatable as follows: "In general, translocation is regulated by the vital activity. By this the functioning apparatus is controlled, and apparently the organism is capable of modifying the permeability of the protoplast temporarily in many ways. Indeed, it is not improbable that the living protoplast, by its own activity, not only conducts solid particles and oil drops, but also under some circumstances dissolved substances for which it is not diosmotic. Furthermore, diosmose is not dependent entirely upon the size of the dissolved molecules, since many colloids may be easily taken up and given off."

The terse, vigorous, concise style and generally high literary quality make this volume a classic in botanical literature. The author has rendered an inestimable service to biological science by his masterly criticism and arrangement of the accumulated results of research upon the physiology of the vegetal organism, and his vivid clear-cut delineation of the problems awaiting investigation will give a new impetus to research in this and related lines.

Arrangements have already been made for the translation of the book into French and English. The English edition will be prepared under the direction of Dr. Ewart, whose intimate acquaintance with the author and important researches in the Leipsic Institute make him especially well fitted for the task.

D. T. MacDougal.

Trail and Camp Fire, the Book of the Boone and Crockett Club. Editors: George Bird Grinnell and Theodore Roosevelt. New York, Forest and Stream Publishing Co. December, 1897. 8vo. Pp. 353. Illustrated. Price, $2.50.

Beginning in 1893, the Boone and Crockett Club has published on alternate years a volume made up of articles on big game and big game hunting, with tales of exploration in little known lands. While written primarily for the sportsman, these books contain much of interest to the naturalist; and to the student of the larger mammals they are indispensable. The new volume, 'Trail and Camp Fire,' contains the following: 'The Labrador Peninsula,' A. P. Low; 'Cherry,' Lewis S. Thompson; 'An African Shooting Trip,' Wm. Lord Smith; 'Sintamaskin,' C. Grant LaFarge; 'Wolves and Wolf Nature,' George Bird Grinnell; 'On the Little Missouri,' Theodore Roosevelt; 'Bear Traits,' George Bird Grinnell, J. C. Merrill, Theodore Roosevelt and Henry L. Stimson; 'The Adirondack Deer Law,' Wm. Cary Sanger; 'A Newfoundland Caribou Hunt,' Clay Arthur Pierce; 'Origin of the New York Zoological Society,' Madison Grant. To these is added a chapter on 'Books on Big Game'—one of the most entertaining and useful in the volume—treating of the more important works on big game hunting in Africa, India and America.

Trustworthy information relating to the interior of the Labrador peninsula is so scarce that Mr. Low's article will be widely welcomed and will reach a different audience from his much more elaborate official report (Annual Report Geological Survey of Canada, N. S., Vol. VIII., pp. 1–387, Ottawa, 1897). It is a pity that his important notes on big game are marred by antiquated and inaccurate nomenclature.

Without attempting to point out the many good things in the book, it may be said that the chapters on Wolves and Bears are intensely interesting, and that Mr. Wm. Lord Smith's account of his 'African Shooting Trip,' in company with Dr. A. Donaldson Smith, is an important addition to the literature of the rapidly diminishing game of the 'Dark Continent.'

The editors' statement that "coyotes try to

catch and eat badgers" seems to need some sort of qualification. The reviewer and at least one of his associates have on several occasions seen coyotes and badgers cross each other's tracks, without the slightest show of fear or aggressiveness on either side; and persons familiar with the strength, ferocity and resisting powers of the badger can hardly imagine a coyote rash enough to meddle with one. Of course, a hungry coyote might tackle a young or enfeebled badger, but in the case of adults in ordinary health and spirits it is hard to believe that a coyote would ever invite such a terrible contest.

'Trail and Camp Fire' is a storehouse of information for the sportsman-naturalist and a worthy companion of 'American Big Game Hunting' and 'Hunting in Many Lands,' its predecessors in the Boone and Crockett series.

C. H. M.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 480th meeting was held at the Cosmos Club on Saturday evening, February 19th, at 8 p. m. The first paper was by Mr. H. A. Hazen on 'The Origin and Value of Weather Folk-lore.' In substance Mr. Hazen said: "A weather saying or sign to be of value should be based on a sufficient number of coincidences between the sign and the supposed resulting weather to make it a law." It was shown that four-fifths at least of the current weather signs and proverbs could not be regarded laws. "The earliest of these signs, some think, is in Job [Canst thou bind the sweet influences of the Pleiades], but this refers only to the fact that, before the calendar month and year were established, the rising and setting of the constellations were taken by the ancients to mark the seasons and the times of sowing and harvesting. There is no thought that the Pleiades have any direct influence upon terrestrial conditions. Hesiod (850 B. C.) gives the cuckoo (rain crow) sign of rain, and it is a little remarkable that this early sign has come down through the ages as the best animal sign of rain."

The author spoke of pseudo weather lore; signs from the moon (universal in civilized nations); from the planets, which may be brought down to the planetarians of the present day; from eclipses, clouds, halos; from animals, birds, etc.

The second paper was by Mr. W. H. Dall, who spoke on the condition of Tertiary Paleontology in the United States. The speaker restricted himself to a consideration of the fossil invertebrates of marine origin. He briefly sketched the history of this branch of American science, from its beginnings with Say, Morton, Lea and Conrad, to the present time, showing how, after the energy of the earlier Philadelphia school had spent itself, a period of comparative inaction set in, which had now given way to renewed activity, which is gradually placing this branch of the science on a modern basis. This awakened interest is largely due to the initiative of the Wagner Free Institute of Science in Philadelphia and the extension of the work of the United States Geological Survey to the coastal plain and phosphate regions of the Southern States.

E. D. PRESTON,
Secretary.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO, MEETINGS OF DECEMBER AND JANUARY.

Maturation and Fertilization of the Egg of Arenicola Marina. In the earliest stage in which centrosomes have been seen, there are two, at some distance from each other in the cytoplasm, each surrounded by a small, deeply staining area, and few, very delicate radiations. The rays elongate, a large spindle is formed, and the chromosomes, now lying free in the cytoplasm, arrange themselves upon it. In approaching its definitive position at the pheriphery of the egg, this first polar spindle contracts to about one-half its original length. The centrosomes at each pole divide as the separation of the chromosomes begins. The two centrosomes at the inner pole form the poles of the second polar spindle. They move apart, showing a central spindle, new asters appear, and the spindle assumes the position occupied by the first polar spindle.

After the formation of the second polar body the female pronucleus is formed, and the 'female' centrosome and aster disappear. The sperm apparently enters at any point, but cannot be

distinguished from yolk granules at first, as, for some time, no 'male' aster appears. Later, however, the sperm-head enlarges and an aster and centrosome appear, the centrosome divides and two asters are formed connected by a spindle. All of these disappear, however, at the same time as the female aster and centrosome.

When the two pronuclei come into contact no centrosomes or asters are visible in the egg. The two pronuclei as a whole form the center of a large radiation extending nearly to the periphery of the egg. A little later a very minute centrosome and aster appear on each side of the pronuclei in the copulation plane. Both centrosomes and asters increase in size, one being larger than the other (the first cleavage is unequal), fibers extend past the pronuclei from one centrosome to the other and the first cleavage spindle is formed. The pronuclei elongate and lose their membranes without preceding fusion. As the astral rays elongate, the radiation which surrounded the pronuclei disappears and the cytoplasm rearranges itself as the rays of an aster centering about a centrosome.

C. M. Child.

Notes on the Peripheral Nervous System of Molgula Manhattensis. The intra-vitam method of methylene blue staining was used. Sensory cells occupying a lateral position in the endostyle were found. These cells are characterized by a distal knob or spike and one or more proximally placed enlargements, one of which contains the nucleus. Some cells showed protoplasmic (?) branchings. No supporting cells were seen. Nerve fibrils, after leaving the epithelium, turn sharply at right angles to run longitudinally as separate fibrils or in loose bundles. They probably reach the (brain) ganglion by the circumbuccal nerves.

The endings in the branchial basket are knob- or disk-like. Nerve fibrils may end on cells in the walls of the branchial bars or freely. Fibrils may lie in the supporting tissue or be applied to the base of the epithelium, and, singly or in bundles, anastomose to form a true plexus. Ganglion cells are found. Fibrils end on the basal part of mucus or ciliated cells in club or disk-shaped endings. Other fibers touch the base of a cell with a knob-like varicosity and continue their course, touching neighboring cells in like manner before finally ending.

A sub-epithelial plexus was found in other parts of the body. Nerve endings were found in the muscles and ciliated funnel. The sensory nature of the tentacles and papillæ of the peribranchial sac was not demonstrated.

G. W. Hunter, Jr.

During the two months the following reviews and papers were also given: 'Recent Literature on the Embryology of Insects' (Uzel and Heymons), Dr. W. M. Wheeler; 'The Lithodidæ, a Family of Asymmetrical Crabs,' S. J. Holmes; 'Theories of Animal Phosphorescence,' Dr. Watasé; 'Some of the Functions and Features of a Biological Station,' Dr. Whitman; 'Recent Literature on Regeneration' (Joest), W. H. Packard; 'A Review of Some Recent Work on Spermatogenesis' (Bardeleben), M. F. Guyer; 'Experimental Work on the Cilnophore Egg' (Fischel), Dr. Child; 'The Pronephros in Teleosts' (Felix), Miss E. R. Gregory.

TORREY BOTANICAL CLUB.

At the annual meeting, January 10, 1898, cash balances to the favor of the Club were reported by the Treasurer and the Editor.

The Recording Secretary, Professor Burgess, reported an average attendance of 35 at the 15 meetings held during the year, one death, a present active membership of 213, corresponding membership of 153, honorary membership of 4, total 370. Thirty scientific papers have been presented.

The Editor, Dr. Britton, reported the regular monthly publication of the *Bulletin*, including 592 pages, 33 plates and 1 portrait; and the publication of Vol. VI., No. 2, of the *Memoirs*, containing 80 pages, issued July 30, 1897.

Dr. Small reported for the Field Committee that field meetings were arranged for every Saturday from April 24th to October 30th, and also on election day—29 excursions in all. These were usually half-day excursions, with 4 of the whole day and 4 of two days each. They have extended into the neighboring mainland of New York, into Long Island, Staten Island, New Jersey and Pennsylvania. The average attendance upon the excursions was about 16, and the average number of plants specially recorded 48.

Dr. Rusby, in behalf of the Committee on Program, announced arrangements in progress relative to presentation of several interesting topics before the Club by botanists from other cities.

The fourth order of business was the annual election, resulting in the main in the re-election of the previous officers. The Treasurer, Mr. Ogden, and the Editor, Dr. Britton, on account of pressing present obligations, declined re-election. Their services, rendered for a long series of years, elicited remarks of hearty appreciation.

The officers for 1898 include the following: President, Addison Brown; Vice-Presidents, T. H. Allen, H. H. Rusby; Treasurer, Maturin L. Delafield, Jr.; Recording Secretary, Edward S. Burgess; Corresponding Secretary, John K. Small; Editor, Lucien M. Underwood.

Discussion on the development of the tomato and strawberry followed.

Professor Lloyd spoke of the work of Professor L. H. Bailey upon the origin of the tomato, and exhibited illustrative specimens loaned by Professor Bailey, with others to indicate that *Fragaria Chilensis* is the source of the cultivated strawberry. He also exhibited the original specimen of the strawberry known as Hovey's Seedling.

Dr. Rusby spoke of his experience with the *Fragaria Chilensis* as cultivated in the Bolivian Andes, where, at 10,000 feet altitude, its growth is luxuriant, standing up nearly to the knees. Its fruit is large and juicy, does not keep well, and is without flavor or fragrance. It bears continuously, and he ate from it every month of the year but two. Its identity with the coast form was questioned by Dr. Britton.

Dr. Rusby also exhibited a sample of *Fragaria Mexicana*, by some identified with *F. Chilensis*, and by others with *F. vesca*, but which keeps well and is high flavored.

EDWARD S. BURGESS,
Secretary.

SCIENTIFIC JOURNALS.

The Journal of Geology for January–February, 1898, contains papers on the following subjects: 'An Hypothesis to Account for the Movement in the Crust of the Earth,' J. W. POWELL. After a preliminary introductory statement, the general disturbances of an organic and epeirogenic character are explained by the principle that under sufficient loading, rocks flow; but that the modulus of compression varies for different rocks, and for the same rock as its critical point is approximated. As this point is reached freedom of molecular movement may even become so marked as to cause recrystallization. All these changes tend to produce upheaval and subsidence. 'Estimates and Causes of Crustal Shortening,' C. R. VAN HISE. The author considers the crustal shortening to have probably been much less than is generally assumed and, after a discussion of its various effects and concomitant phenomena in rocks, takes up the following conceivable causes: secular cooling, vulcanism, cementation, change of pressure, change in physical conditions, loss of water and gas. 'Note on the pressure within the earth,' by CHARLES S. SLICHTER. The paper discusses "the magnitude of the pressures within the earth-spheroid, especially as influenced by the changes that have been brought about in the ellipticity of the earth's figure by its changing rotation period." 'The geological *versus* the petrographical classification of igneous rocks,' by WHITMAN CROSS. The paper distinguishes the petrological from the petrographical point of view in rock classification and in a very temperate and excellent manner advocates the latter for systematic classification, the former for theoretical discussion. No actual scheme is, however, advanced. The paper was read at the Montreal meeting of the Geological Society of America and has been previously abstracted in these columns (p. 83). 'On Rock Classification,' by J. P. IDDINGS. With several very suggestive and comprehensive diagrams the author discusses the chemical relations of the igneous rocks. The paper was read at the Montreal meeting of the Geological Society of America and has been previously reviewed in these columns (p. 83).

American Chemical Journal, February.—'On the Action of Acetic Anhydride on Phenylpropiolic Acid': By ARTHUR MICHAEL and J. E. BUCHER. The authors find that in

this reaction polymerization takes place with the formation of a naphthalene compound. 'The Relation of the Taste of Acids to their Degree of Dissociation': By T. W. Richards. The relative strength and extent of dissociation of dilute acid solutions can be determined approximately by the sense of taste. 'Note on Fehling's Solution': By J. B. Tingle. The ordinary solution containing tartaric acid is reduced even at the ordinary temperature if it has been partly neutralized with the free mineral acids and also decomposes spontaneously if allowed to stand. It is, therefore, necessary to use a freshly prepared solution. If, however, glycerine and ammonium hydroxide are used, instead of the tartaric acid salt, a solution is obtained which is perfectly stable. 'Action of the Anhydride of Orthosulphobenzoic Acid on Dimethyl- and on Diethylanaline': By M. D. Sohon. Formation of the corresponding aniline sulphonphthaleins. 'The Molecular Weight of Lactimide': By G. M. Richardson and M. Adams. The evidence speaks in favor of the double formula. 'The Action of Sodium Ethylate upon α, β—Dibromhydrocinnamic Ester, Citradibrompyrotartaric Ester, and α, β—Dioxompropionic Ester': By V. L. Leighton. 'On some Bromine Derivatives of 2, 3,—Dimethylbutane': By H. L. Wheeler. 'Phosphatic Chert': By J. H. Kastle, J. C. W. Frazer and Geo. Sullivan. Analyses of phosphatic limestone. 'On the Effect of Light on the Combination of Hydrogen and Bromine at High Temperatures': By J. H. Kastle and W. A. Beatty. Light causes the combination of hydrogen and bromine at 196°.

J. Elliott Gilpin.

The *Zeitschrift für den physikalischen und chemischen Unterricht* (Berlin, Julius Springer) deserves to be better known than it is by the teachers in our secondary schools. The ten volumes now completed are full of valuable matter bearing upon the teaching of physcial sciences. In the first, January, number of the eleventh volume, the editor, Dr. Poske, reviews the history of the journal, reaffirms strongly his frequently expressed opinion of the humanistic character of all proper general physical instruction, and urges teachers to make less of theory and hypothesis and more of experiment and experience. Then follow some notes by that wonderfully bright and prolific writer, Professor Mach, of Vienna, one of the associate editors, upon the 'Historical Development of Optics.' Dr. Strecker, of Berlin, writes upon theory and practice in the construction of rheostats for small physical laboratories. Then follows an article upon the nature of visible water-vapor and its experimental production before a class. Then we have Professor van't Hoff's paper of last summer before the Scientific Congress in Berlin on 'Stereo-chemistry.' Descriptions of new apparatus and experiments, historical notes, courses and methods of instruction, technics and mechanical praxis, new books, reports of scientific societies, and astronomy for the year, with maps, complete the volume.

E. A. Strong.

Ypsilanti, Mich.

NEW BOOKS.

Leçons sur l'intégration des équations aux dérivées partielles du second ordre a deux variables indépendantes. E. Goursat. Paris, A. Hermann. 1898. Vol. II. Pp. 344.

Peneroplis, eine Studie zur biologischen Morphologie und zur Speciesfrage. Friedrich Dreyer. Leipzig, Wilhelm Engelmann. 1898. Pp. vi+119+5 plates. 10 Marks.

Pasteur. Percy Frankland and Mrs. Percy Frankland. New York, The Macmillan Co. Pp. vi+224. $1.25.

Angewandte Elektrochemie. Franz Peters. Wien, Pest, Leipzig. A. Hartleben's Verlag. Vol. 2. 1st part, pp. xi+248; 2nd part, pp. xii+215.

The Arrangement of Atoms in Space. J. H. Van't Hoff. Second revised and enlarged edition; translated and edited by Arnold Eilvart. London, New York and Bombay, Longmans, Green & Co. 1898. Pp. vi+211.

Spectrum Analysis. John Landower. Authorized English Edition by J. Bishop Tingle. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. 1898. Pp. x+239.

Outlines of Descriptive Psychology. George Trumbull Ladd. New York, Charles Scribner's Sons. 1898. Pp. xi+428. $1.50.